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SOCIAL IMPLICATIONS OF VITAMINS[1]

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THE theory of evolution has profoundly influenced the philosophical and religious thought of our generation as well as that of its predecessor. In alliance with the sciences of genetics and neurology it has shaped much of our thinking concerning the psychological and nervous organization of the human personality. At one time, especially under the influence of Herbert Spencer, the evolutionary concept had a profound influence upon theories of government and social organization. Perhaps it would not be going too far to say that the doctrine of *laissez-faire* had for a generation some of its main roots in the soil of our views of the evolutionary process. In the present day of world-wide acceptance of planned economies and of various forms of paternalistic regimentation *laissez-faire* has become disreputable and scarcely any one is so poor as to do it reverence. Increasingly, popular thought classifies human social organization as a thing apart from nature, something to be dealt with as seems to us expedient.

Believing that it is a grave mistake to divorce any broad aspect of human life from its setting as a part of nature, I beg your indulgence to-day in departing from the shop talk of chemists, namely, chemical compounds and chemical reactions, and ask you to consider with me what man may learn from chemistry

[1] Lecture given on the occasion of the fiftieth anniversary celebration of the University of Chicago, September 22, 1941.

about how his own life may be reshaped with a maximum promise that it shall turn out nearer to his heart's desire.

The Darwinian theory of evolution drew its more certain data largely from morphology and particularly from the shapes of the skeletal remains of living creatures which have left their imprints in the rocks. This trustworthy morphological evidence was embellished and fortified with many rather speculative inferences from the conduct habits of creatures still living. This latter type of evidence has been increasingly discredited in our own times. The remaining morphological evidence presents relatively minor similarities amid major contrasts of the forms lying but a few inches or a few feet apart vertically in successive strata of the rocks. So long as the soundness of the idea of development of species by progressive changes was in dispute, the tendency was to emphasize how great changes may occur without complete eradication of tell-tale similarities. Alteration was exaggerated and the persistence of inherited traits was minimized so that, for the popular mind at least, the time scale was unduly foreshortened.

Consideration of the chemical descent of man, emphasized particularly by our new knowledge of the vitamins, corrects in great degree the illusory sense of gross, rapid and radical alteration suggested by morphology. It brings into prominence the underlying conservative principles in nature. Vitamin chemistry brings new and more intimate visions of the steps of evolutionary progress, for we find chemical evidences of community of inheritance in living things so far separated in the evolutionary scale that nearly all similarities of outward form have been erased. The far more pervasive and persistent chemical inheritances permit us to verify the successive inventions which have made an expanding life possible and to enrich the record with manifold new details.

Let us now review briefly the chemical evidence in support of the common inheritance of all living things. First, we should recall for the benefit of those less versed in chemistry that living matter is composed predominantly of compounds of carbon. Carbon, of all the elements, possesses the singular property of uniting with itself to form long chains which may be straight or forked or may double back upon themselves to form single or multiple rings. Occasionally an atom of nitrogen, oxygen or sulfur is enticed into a place in these chains or rings, but predominantly living matter is an interlacing linking of carbon to carbon with hydrogen atoms clinging at the sides of each carbon along the chains.

The significance of this peculiarity of carbon compounds may perhaps be rendered clearer by an analogy. The compounds of other elements which make up inorganic nature may be compared to discrete word signs such as the Chinese use. There have to be as many signs as there are words to be expressed. By contrast carbon atoms resemble letters of an alphabet which may be linked together to form thousands of words from a few characters. The analogy is not perfect, for all carbon atoms are alike while the letters differ from one another, but the lack of diversity of carbon atoms is more than offset by the great variety, complexity and size of the spatial arrangements which they form, arrangements which we call molecules. There are approximately as many known compounds of carbon as there are words in the English language, and the structural formulas of even relatively simple ones often contain more characters than a German jaw-breaker.

It is a commonplace that the derivation of words in Caucasian tongues can be traced readily by the recurrence of familiar sequences of characters, often modified according to accepted rules. When one examines the significant carbon compounds which occur in living matter, one can not fail to be astounded by the recurrences of identical compounds throughout the entire evolutionary scale from unicellular microscopic yeasts to man himself. When one considers the scores, or hundreds, or even thousands of patterns into which those same carbon atoms might have arrayed themselves, any explanation of such recurrences of identical compounds, other than that of the common chemical inheritance of all living things, becomes virtually impossible.

In considering the complex carbon compounds which recur again and again in living nature, we shall pass over those which are common to animal forms alone. Among these are the hormones secreted by the endocrine glands. The use in human medicine of extractives from the glands of oxen or sheep is of course based on the fact that the active compounds are normal products of the physiological activity of man and beast. Thyroxine, for example, controls basal metabolism for frog, snake, bird and mammal.

We shall turn rather from these near relatives of ours and survey what is common to a much wider range of living things. We may mention first the role of glucose in nature. This substance is present to the extent of about five grams in the blood streams of each of us at this moment. Turn where you will, you will find it also in other blood streams and in the saps of plants, not as a trace substance but as an important intermediate of vital processes. The green plants make it from carbon dioxide and from it they produce starch and proteins. These plant carbohydrates and proteins are degraded by animals which consume them as food. In doing so, the animals retrace the downward steps again to glucose which is

in common burned as the source of vital activity, heat and mechanical work. Even the degradation of glucose to spent carbon dioxide and water we evidently learned from very distant progenitors for the process of glycolysis in our muscles follows for the most part a pathway common to that used by the humble yeast cell in the process of alcoholic fermentation. Many of the intermediate stages are identical.

If this were a single instance, it might be supposed fortuitous. Water is equally or even more universally and uniformly distributed in living things. As it is also abundant in inorganic nature, it is quite conceivable that the various forms of life just happened to incorporate water in their systems. Glucose differs in that it is not present in the inorganic world in perceptible amounts. However, the significance of the community of its role in living things rests on something far more profound than that. The metabolism of glucose follows a common pathway in diverse living things because it proceeds by the action of a whole series of complex organic catalysts known as enzymes. These enzyme molecules are too vast and complex for the chemist to decipher completely to-day, but we can now say that the prosthetic groups or business ends of these molecules are in many instances what we earlier came to call the vitamins. These vitamins are, therefore, the bits, the working ends, of the keys which unlock the stores of vital energy from glucose and other foods. The keys are master keys which perform the same function within the cells of all living things alike, to the best of our knowledge and belief. Since the keys turn smoothly in a thousand locks, can we suppose otherwise than that the keys and locks were fashioned by the same hand and mind when life first began to breathe?

There are many of these chemical mechanisms common to plants and animals. Vitamin C is a characteristic constituent of plants during growth but not during dormancy. Sprout a seed and vitamin C appears overnight. It is also present in the tissues and particularly in the livers of all animals so far examined. Man, the monkey and the guinea pig have to get it from the plants; other animals can make it for themselves. Vitamin E, occurring in wheat germ and lettuce leaf, is essential to the fertility of mammals. Oestrone, a mammalian female sex hormone, produces visible stimulation of the growth of young pea seedlings.

Still more conspicuous examples are found among the members of the vitamin B complex. Of these no other quite equals B_1, the antiberiberi vitamin, in the profundity and universality of its essential action. It is present in every living tissue which has been critically examined. It is demonstrably required not only by every common mammalian species including man but is also indispensable for flies, beetles, certain worms, bacteria, molds, fungi and yeasts. The higher plants fabricate hundreds of tons of it annually and store it in their seeds in quantity. Without it the sprouting seed can not form a root system. This may be demonstrated by sprouting tomato seeds in water and cutting off the rootlets when they have grown to a length of a half inch or so. The severed roots are then transferred to a solution of pure sugar and small amounts of nutrient salts. No further growth of the rootlets occurs unless vitamin B_1 is also added to the solution. If added in amounts ranging from one part in 40 million million to one part in 40 million, growth of the roots occurs in proportion to the amount added.

Vitamin B_2 or riboflavin also enters into several enzymes as part of the wide-spread oxidative mechanisms of living things. It occurs in most plant tissues and plays a role there like it plays in animals. Recently its importance in human nutrition has been emphasized by clinical observation of eye disturbances and lip sores which respond with amazing rapidity to small doses of the yellow pigment. A deficiency of it is now rated among the four or five most important deficiencies in the American diet, but the immediate causes of the shortage are not yet clear.

Nicotinic acid, a familiar substance, long known to chemists as a constituent of foods, turned out only four years ago to be the pellagra vitamin. Thousands of people died in the insane asylums of our South for lack of it and many thousands more still suffer some degree of impairment from a shortage of supply. Even before its efficacy for the treatment of pellagra was published evidence was forthcoming that staphylococcus, the common pus-forming organism, finds it equally indispensable for its humble life, as do also the roots of tomato plants. It is the prosthetic group of cozymase which floats in our blood stream and in the fluid contents of yeast cells, performing in each the same necessary function.

Another member of the B complex is pyridoxine, which was first found essential for the growth of rats and for the prevention of a dermatitis long confused with true pellagra. Its utility for several plants and microorganisms was tested at a venture with positive results. Tomato roots and certain molds, for example, require it as man does. It is coming into a limited use in human medicine.

The worth of most of the vitamins was first proved for animals, and it was not till many years had elapsed that attempts were made to prove that plant tissues which supply them actually fabricate them for their own needs. There are, however, three vitamins which were first recognized as growth substances for plants and were tried on animals only years later. These three are inositol, pantothenic acid and biotin.

They were known as useful for plants about fifteen, ten and five years respectively, before their animal functions were recognized. From these experiences, biochemists have come to feel that utility of a new natural substance in either kingdom justifies tentative presumption of utility in the other.

All these substances have been isolated in a pure state from nature and the structure of all of them except biotin has been determined and verified by synthesis. In general, their structures are highly specific and slight alterations of nature's pattern result in physiological inutility for the whole range of the evolutionary scale. Their structures vary greatly in complexity from one vitamin to another and there are no features which are common to them all. Each of them apparently represents an independent invention made by some of our common forebears and handed down impartially to all their heirs. The leaves of the ginkgo tree whose imprints, estimated to be twenty million years old, are found, true to the modern pattern, in the carboniferous rocks, as well as the leaves of the latest Burbanked fruit alike make the same vitamins and utilize them for the internal economies of the plants. The animals came much later than plants and can claim no share in the inventions but only in their adaptive application. More and more we who have long boasted ourselves as lords of creation find that we are also mendicants in nature's bread line and heirs of the grass of the fields.

So much for the water-soluble vitamins. The special function of the quite dissimilar fat soluble vitamins is less clear. They are not known to be components of enzyme systems, but they do definitely belong to both plant and animal kingdoms.

The existence of vision in animals is one of the outstanding marvels of nature. That the light reflected from a distant object can produce a faithful image in the consciousness of creatures at humble levels of the evolutionary scale seems to the reflective mind a miracle of adaptation. If all life were to be wiped out and the whole drama of evolution reenacted, would sight come again to the earth? If so, would nature employ new agencies or resort again to her lost art? That the latter might be the case is suggested by the fact that the photochemistry of vision appears to be similar wherever we encounter it.

The retinas of most vertebrates contain two groups of light receptors distinguished by their shapes as rods and cones. The rods function in dim light; the cones, in bright. Both rods and cones contain closely related photopigments which comprise a carotenoid in combination with a protein. Just as light affects the silver halide in your camera film and makes a picture from the varying darkness of the resulting silver particles, so light bleaches these pigments in each microscopic rod and cone to make an image on the retina which is somehow transferred along the optic nerves to our brains and our consciousness. The photopigment of the rods is called rhodopsin or visual purple. It is a compound of a giant protein molecule with a molecule of vitamin A. By exposure to light, this compound is partly split into free protein and free vitamin A. The two cleavage products, however, are constantly recombining. In the dark, the recombining process overtakes the splitting process so the eye is fully rested to see again.

Before discussing further the function of vitamin A in the rods, let us refer briefly to the cones which contain a closely related violet pigment called iodopsin which also bleaches to a substance which is probably a simple derivative of vitamin A. Its chemistry is yet to be fully worked out. In chickens, color vision is achieved by three light filters, each consisting of colored oil globules. Wald has fractionated from the red globules a red hydrocarbon, astacene, the substance which gives the characteristic color to a boiled lobster, from the yellow globules the golden xanthophylls, lutein and zeaxanthin, which give also color to the yolks of chicken eggs, and from the third type of globules an unidentified greenish yellow carotene which appears to be identical with the coloring matter of the bacterium *Sarcina lutea*.

Let us now consider the molecular structure of carotene, the yellow coloring matter of carrots from which the name is derived. It comprises two six-carbon atom rings attached to either end of a straight chain of eighteen carbon atoms. From carotene the animal body can and regularly does derive vitamin A by splitting the chain in two in the middle and introducing the hydroxyl group, OH. There are many other carotenoids similar in structure to carotene or vitamin A but differing from them in the length of the chain, the position of the double bonds in the side chain and in the number of hydroxyl groups on it.

It is now clear that all vertebrates have constructed their visual systems by elaboration of a single theme. The isolation and identification of visual pigments is difficult chemistry and little has been done with the lower forms of life. Rhodopsin has recently been found in large quantities in the eye of a squid and such other fragmentary evidence as exists strongly suggests that some other invertebrates see by a closely kindred mechanism.

Perhaps we see beauty in verdant landscapes because our eyes mystically sense a kinship with the colors of the scene. If one prepares a water-free extract of the pigments of leaf or flower, protecting them the while from atmospheric oxidation, he can effect a beautiful separation of them into their prin-

cipal class components by simple means. It is only necessary to filter the extract slowly through a close-packed column of fine chalk, and color bands appear which become sharper as more fluid passes through. At the bottom are the yellow carotene bands which may be driven lower by pouring still more fresh solvent through the filter till the yellow colors collect in the flask at the bottom. From carotene, as we have already seen, all animal life is able to derive vitamin A. Without it there ensues blindness and general failure of the body mechanism.

Next, above the carotene band in our filter column are the reddish orange xanthophylls whose chemistry is unfortunately less well understood. They are, however, related to the hydrocarbon carotenes and differ from them principally by being dialcohols. (Vitamin A is a monoalcohol.) Among the xanthophylls which have been isolated is the red pigment of the tomato, lycopin and fuco-xanthin which colors the brown algae in our ponds. Another xanthophyll has already been mentioned as an essential component of the light filter of a chicken's eye and also as present in the yolk of its egg.

Above the xanthophylls in our filter column appear the green bands of the chlorophylls. Here is the spectrum of nature's color beauty: the yellow of the carotenes, the reds of the xanthophylls and the blue greens of the chlorophylls. Herewith she bedecks the flowers, fruits and foliage of her myriad higher plants and has some to spare for the wattles of the turkey and for the bodies of inconspicuous and forgotten primitive bacteria, mosses and fungi.

Something very like chlorophyll is in your blood—at least a huge portion of its molecular skeleton is there. Hemin is the prosthetic group or business end of the hemoglobin of mammalian blood. It contains four pyrrole rings joined in a giant circle with four intervening CH groups. At the center is an atom of iron which is "it" in this game of ring-around-the-rosy. The molecule of chlorophyll shows the same players in the same game except that now magnesium is "it." It is true that some of the little girls have different ribbons on their pigtails, but you could not mistake their identity.

Their common structural element is known as porphyrin. This vast carbon-nitrogen skeleton recurs again and again in the breathing systems of plant and animal life as an integral part of the substances which we have come to refer to as the respiratory pigments. When the hemin of blood is heated with soda lime, porphyrin is obtained identical in every detail with the porphyrin derived from chlorophyll. When you peel an apple with a steel knife and see the fresh cut surface darken presently in the air, you are witnessing the action of a porphyrin-containing oxidase. Put a drop of hydrogen peroxide on the surface and watch the oxygen evolve due to another porphyrin-base enzyme of the apple or of most any other vegetable tissue. It is called catalase.

Another well-nigh if not universal constituent of tissues is cytochrome, which may be recognized with a spectroscope by its absorption bands associated with its porphyrin nucleus. If yeast is kept from contact with the air the cytochrome bands appear strongly. They fade and return as oxygen is admitted and again excluded. Choke a wax moth and the absorption bands of cytochrome appear throughout its body tissues, the more quickly as its struggles exhaust its internal oxygen supply. Let it breathe freely again and the bands disappear. Cytochrome is one of a number of links in the chain whereby glucose is oxidized by living tissues. It serves to transfer oxygen from the air to the food molecule which is to be oxidized. We do not know that animals depend on plants in any way for their daily supplies of porphyrin base enzymes, but we can guess whence they inherited the skill to use them.

Surely we need not labor through further examples. The revelation provided by vitamin chemistry seems sufficient to convince the skeptic that while nature has *altered* much in proceeding from amoeba to Einstein or Dorothy Lamour, she has *preserved* even more through all the vicissitudes of evolutionary history.

(*To be concluded in the issue of Science for November 28*)

THE USE AND MISUSE OF SCIENCE IN GOVERNMENT[1]

By Dr. A. V. HILL, M.P.

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In this country we do not believe in bureaucracy. Our national genius has evolved a system by which the activities of officials are continually subject to the advice and help and criticism of public-spirited citizens. The wise officials appreciate this; the stupid ones do not. Let us never abandon this principle, otherwise, with our traditions, we are in for a long spell of trouble. Let us rather praise and extend it, whatever our totalitarian youth may say. One way to extend it is to insist that independent scientific advice shall be given a constitutional place, and a con-

[1] From an address given at the Conference on Science and World Order of the British Association for the Advancement of Science, organized by the Division for the Social and International Relations of Science.

stitutional right to be heard, in government departments.

Even, however, if departments were saturated with scientific advice, it would still be necessary to ensure that the Cabinet itself should be properly served. The Scientific Advisory Committee and the Engineering Advisory Committee, both under the chairmanship of Lord Hankey, now fulfil that function here. The arrangement is new, but undoubtedly it works well. Dealing as they do with the reactions of science and technology with policy, at present particularly but not exclusively in connection with the war, the committees can not busy themselves with details which naturally go to departmental bodies, and most of their activities can not in wartime be publicly described. The chairman, as a minister of high rank, working under the Lord President of the Council, who is the member of the War Cabinet primarily responsible for research, has access to all ministers and departments. A new link has thus been forged, and science at last is in contact with the center of government.

In the United States a similar link exists. The director of the Office of Scientific Research and Development in Washington is directly responsible to the President. Under this organization come the National Defense Research Committee, the National Advisory Committee for Aeronautics and the Medical Division of the National Research Council. This arrangement is quite new, and in many ways different from our own; but it is like it in the sense that in the United States, as here, science now has direct access to the center of government. May it so continue in both countries!

I have dealt with the attitude of mind from which the problems of science in government must be approached, and with the organization needed at departmental and Cabinet level. It remains now to deal with the scientists themselves and the problem of how to keep them alive. It is essential, if the scientific minds of the scientists in government employment are to be saved from sterility, and their souls perhaps from damnation, that there should be as little distinction as possible between them and those in the universities, in industry and in other independent institutions. In wartime there is little distinction; we are all in it together. What I say applies to the more normal times of peace.

Government scientific employment in general has certain characteristics:

(1) It has security of tenure, fixed hours of work, regular promotion and a pension.

(2) Adequate equipment is usually available, and there is not a continual struggle for funds.

(3) The object and direction of investigation are usually laid down by authority.

(4) Discussion and publication are usually limited, sometimes because of the real or alleged necessity of secrecy, often simply by tradition.

(5) Teaching duties generally do not exist, and there is often no necessity to follow the scientific literature except in a special field, with the result that interests are likely to become narrow.

(6) Attendance at meetings of learned societies, conferences and congresses, the holding of colloquia and discussion meetings and contacts with scientists in other fields are rare.

(7) Visiting workers, particularly foreign workers, are few or absent altogether.

For such reasons, unless a man has exceptional ambition and originality, his initiative and keenness tend to be blunted. There are several ways to avoid this:

(*a*) To ensure that directors of research, heads of laboratories, etc., are people of exceptional quality, not only in ability, originality and experience, but also in their human relations and sympathy. Such men in such positions are rare, but they exist; their value is very great. It is essential that they should remain investigators at heart, and as far as possible in action, and not become mere bureaucrats.

(*b*) To adopt a common pension scheme, similar to that of the Federated Universities System, with the universities, with industrial laboratories and with all institutions in which scientific work is done.

(*c*) To encourage junior and senior workers alike to interchange freely with other departments, with industrial laboratories or with universities.

(*d*) To provide facilities for visiting workers, for colloquia and discussion meetings and for attendance at meetings of learned societies.

(*e*) To adopt a system analogous to that of the reserve of officers and other ranks by which the fighting services prepare for times of emergency. Many of the ablest workers elsewhere would rightly value a period of service in government laboratories, although not prepared to devote the whole of their lives to it. After their period of service, they would return to their chosen jobs in universities and other places, with occasional "refresher" periods later.

I have urged before that this system of building up a reserve of scientific officers should be adopted as soon as normal conditions return. It would be the greatest pity if the many able men who have done such excellent service in Government establishments should then lose touch permanently. Wide-spread support of this proposal has been evident. It has many advantages; sudden expansion in emergency would be much easier, the universities and other institutions would be kept in touch with government scientific establishments, and *vice versa,* those who joined the government service would not be permanently isolated from the scientific workers outside, and the highly interesting and important work which is done in government laboratories would be more commonly appre-

ciated and known. By forming such a reserve, the intellectual status and the fruitfulness of government science would inevitably be raised and the universities would be brought into closer touch with realities.

There is no need to go into details; they can be settled later. The broad principle is that in every way we need to break down barriers between universities, independent research institutions, industrial laboratories and the scientific establishments and service of the government. This can be done by regular interchange of personnel, by a common pension system, by providing in the government laboratories all those facilities for discussion, for meetings, for criticism, for initiative, for collaboration—even perhaps for teaching—which are found elsewhere. We must not be deterred in this project by bureaucratic objections, by false economy, by the red-herring of secrecy or by alleged administrative difficulties. In science also we must deliberately follow the line of our national genius and ensure the fullest cooperation and interchange between independent science and science controlled by the state.

This plan for a reserve of officers and for frequent and regular interchange between different kinds of institutions need not be limited to science; it should be open to the government service as a whole. Drastic changes are needed in the Civil Service. Personal ability and personal integrity, essential as they are, are not sufficient; the outlook, the methods, the organization, the traditions of the Civil Service must be altered, and contact must be maintained with the real world and its methods outside. The war has shown, what many suspected already, that for all its devotion and its high traditions, the Civil Service has largely failed; the same might well be said of Parliament, but that is another matter. Nothing could be better for the Civil Service, for industry, for the universities, than to institute a regular interchange of personnel; to treat the universities as staff colleges to which workers from the Civil Service or from industry return at intervals for refreshment; to treat industry and the Civil Service as the workshops in which for a period university dons can obtain practical experience; to give to government offices a touch with reality, and to industry a touch with national needs, by the mutual temporary interchange of some of the ablest men on either side. We are concerned here to-day primarily with science in government. Science, however, will never be given full scope until a revolution has occurred in the methods and outlook of government itself.

May I finish on a note, not of criticism but of hope? Under the old régime of *laissez-faire*, which we intend that the proper use of science in government shall replace, our public health services were organized mainly on the principle of trying to cure people when they were sick, our architecture on mending the pipes when they burst after a frost, our industry on paying people a dole when they were unemployed, our national defense on getting ready when a war had begun. It is obvious, however, that scientific planning and the planning of our national resources can make many of our troubles unnecessary. By designing our houses properly the pipes need never get frozen up; by proper attention to nutrition, to public health and physical education, sickness can be largely avoided; by deliberate planning of public works, unemployment can be greatly reduced and the standard of living raised; by adopting a period of national service, universal for men and women alike, as the highest form of democracy, we can avoid blundering unprepared again into war, and can add a new dignity to our citizenship. Scientific planning and planning with the aid of science are what we look forward to; planning, however, in which any new order we arrive at is fitted to our traditional freedom.

OBITUARY

WILLIAM ALBERT NOYES, 1857–1941

William Albert Noyes departed this life on October 24, 1941, at his home in Urbana, Illinois, aged 83 years, 11 months.

How familiar the form of such an announcement! It marks the beginning and ending of life, the two covers of the book, but of the contents—particularly rich in this case—not a word.

Dr. Noyes was born in the country near Independence, Iowa, November 6, 1857. His family, of New England Congregational stock, lived under pioneer conditions not favorable to the study of chemistry and physics; nevertheless, as a boy he managed to get hold of some scientific books and became interested in these subjects at an early age. In the midst of farm work he prepared himself for college, almost without a teacher. In the Iowa college of that day little chemistry was taught, but this was supplemented by a large amount of self-instruction. At the end of four years the young man was W. A. Noyes, A.B. and B.S., in spite of the fact that he had taught school every winter to pay expenses. He conducted much of his graduate work himself while carrying a full load of teaching, so that he was able to take his doctor's degree in chemistry at Johns Hopkins under Remsen in a year and a half, before reaching the age of twenty-five.

Such unremitting labor was characteristic of Dr. Noyes throughout his long life. During a year as

instructor at the University of Minnesota he performed much analytical work for the State Geological Survey (just as he later did in Indiana) and began original research of his own. The research was continued at the University of Tennessee, where he was professor from 1883 to 1886. A seventeen-year period followed at Rose Polytechnic Institute, a small school of high grade. This was just the sort of place where many a man, condemned to a heavy teaching load, with improvised equipment and with little or no graduate assistance, would have sunk out of sight; Dr. Noyes attracted the attention of the chemical world by his researches and his books.

From Rose he stepped in 1903 to the position of chief chemist of the Bureau of Standards (the first to hold that title), and from there to head of the department of chemistry of the University of Illinois, where he served with distinction from 1907 to 1926, becoming then professor emeritus. In recognition of his success in building during this period a great department, the university in 1939 dedicated the scene of his labors as the William Albert Noyes Laboratory of Chemistry. Dr. Noyes himself took part in the dedication, surrounded by many staff members whom he had selected. His pathway had been strewn with well-deserved honors: presidency of the Indiana Academy of Science (1894), vice-presidency of the American Association for the Advancement of Science (1896), presidency of the American Chemical Society (1920); degrees from Clark in 1909, Pittsburgh in 1920, and Grinnell(his alma mater) in 1929; memberships in the American Academy of Arts and Sciences, the National Academy of Sciences, the American Philosophical Society; the Nichols medal (1908), the Willard Gibbs medal (1920), the Priestley medal (1935).

Dr. Noyes was married three times. By the first union he leaves W. Albert Noyes, Junior, head of the chemistry department of the University of Rochester; by the second, Charles Edmund, engaged in newspaper and information work in Washington, D. C.; by the third, his widow Katharine Macy Noyes and their sons, Richard Macy, graduate student in chemistry at California Institute of Technology, and Henry Pierre, Harvard undergraduate.

It is difficult in so short a biography to give a true idea of Dr. Noyes' many-sided life work. Perhaps we should first characterize his research, the principal part of which was performed with his own hands. From the oxidation of benzene derivatives with potassium ferricyanide, which links him with his teacher Remsen, he turned to the exact determination of the hydrogen-oxygen ratio, which is at the basis of our system of atomic weights. So excellent was this piece of work that it stands to-day as one of the nearest approaches to the probable truth for this value. His later determination of the atomic weight of chlorine was also outstanding. Methods for the determination of phosphorus, sulfur and manganese in iron constituted a fruitful excursion into the analytical field. During the course of a long series of important researches on camphor Dr. Noyes was the first to furnish definite proof of its present accepted structure (the Bredt formula). Other organic researches dealt with the hydrolysis of maltose and dextrin, molecular rearrangements, optically active diazo compounds and amine oxides. He was active as an investigator almost to the end of his life.

In 1901 a study of the formation of nitrogen trichloride from ammonia and chlorine led Dr. Noyes to the hypothesis that the molecules of elements may ionize into positive and negative parts and to the thought that two kinds of nitrogen trichloride might be capable of existence, one in which the nitrogen is positive and the chlorine negative, and one in which the opposite relations hold. He was thus one of the earliest investigators to recognize that the older conceptions of valence were inadequate to explain experimental facts. From that time on he took an active part in the development of the theory of valence and reactions.

At the turn of the century powerful influences began to operate under which the American Chemical Society, originally a local organization in New York, was destined to become the great national organization that it is to-day. Dr. Noyes was one of the leaders in this development. He saw that the greatest source of strength in such a society lay in disseminating the results of research. His friend Edward Hart had put the *Journal of the American Chemical Society* on its feet; Dr. Noyes took over the editorship in 1902 and held it for fifteen years. Together these men made the *Journal* respected the world over and drew to it the best contributions of American chemists. Besides original articles there had been since 1897 an abstracts section limited to American chemical research. This was not broad enough to satisfy Dr. Noyes. In 1907 he founded *Chemical Abstracts,* summoning to his aid a brilliant corps of nearly thirty assistant editors, and remained its editor for three years at considerable personal sacrifice. Thus he created a "key to the world's chemical literature," as the greatly expanded periodical now justly calls itself. Through the joint efforts of Noyes, Parsons and many others the society grew by leaps and bounds. Dr. Noyes found time to serve as secretary from 1903 to 1907 and as president in 1920. In the latter year he became editor of the series of American Chemical Society Scientific Monographs, a position which he held to his death; he was also the first editor of *Chemical Reviews,* from 1924 to 1926.

As if this varied editorial output were not enough,

several successful text-books bear the name of Noyes: "Elements of Qualitative Analysis," "Organic Chemistry for the Laboratory," "Organic Chemistry" (with a German translation), "Textbook of Chemistry," "Laboratory Exercises in Chemistry," "College Textbook of Chemistry." "Modern Alchemy," a book for lay readers, in collaboration with W. Albert Noyes, Jr., was published in 1932. One need not wonder that Dr. Noyes was often seen at meetings, on the train or at home, with a sheaf of printer's proofs in his hand.

The personal character of William Albert Noyes has been left to the last, but it is the key to all that has preceded. One would judge from his life that genius is fine intellect with capacity for a tremendous amount of hard work. He was first of all a scientific thinker, less affected by emotion or selfish bias than any man the writer has ever known, and utterly unassuming. He was a hard, persistent fighter for whatever he thought was right, and he was right most of the time. Unusual patience, earnestness and the force of example contributed to his success as a teacher. The fabric of Dr. Noyes's achievements was shot through with loyal friendships and strong humanitarian sympathies. Perhaps his deepest interest was religion—a liberal faith which he felt to be in harmony with scientific truth and at the same time a vital faith, something to be lived.

Dr. Noyes was a strong believer in promoting better international understandings as a means of preserving peace and curbing aggression. He felt that scientists, on account of their international community of interest, have a special duty in this field. During the troubled years which have followed the first World War, he made vigorous efforts to draw scientists of different nations closer together. He attended meetings in Europe on different occasions, and published two pamphlets entitled "Building for Peace," besides other articles. His belief never wavered that such efforts, by himself and others of like mind, will finally prevail. Certainly the life and work of William Albert Noyes, distinguished scientist who loved his fellow men, will be no small influence toward the better world of which he dreamed.

AUSTIN M. PATTERSON

U. S. OFFICE OF EDUCATION

MATARO NAGAYO

ON August 16, 1941, Baron Professor Mataro Nagayo, president of the Japanese Foundation for Cancer Research, died of cancer.

He was born on April 6, 1878, in Tokyo, as the third son of Sensai Nagayo, who exerted a great influence on the propagation of Western system of medicine and hygiene in Japan. In 1904 he graduated from Tokyo Imperial University Medical College, and the next year was appointed assistant in pathology in the university. In 1907 he was sent by the government to Europe, where he studied pathology mostly under Professor Aschoff at Freiburg. Returning to Japan in 1909, he was made assistant professor, and in 1911 was promoted to a full professorship in pathology, which he held until 1933. During 1919–1934 he was director of the Government Institute for Infectious Diseases and was most successful in organizing it into a powerful research center. In 1933 he was made dean of the Medical Faculty of Tokyo Imperial University, and in 1934 was elected president of the university. He retired from his duty at Tokyo Imperial University in 1938 with the title of professor emeritus.

Professor Nagayo early became closely connected with the Japanese Foundation for Cancer Research, then called Japanse Society of Cancer Research. In 1915 he became chairman of the executive committee, and in 1929 was unanimously elected president of the foundation. It must be freely acknowledged that the development of the work of the foundation has been almost entirely due to the earnest effort of President Nagayo, and that he is the founder of the Laboratories and Koraku Hospital of the Foundation. With the establishment of the laboratories in 1933 he assumed the directorship.

Professor Nagayo's personal contributions to science include some 200 published papers. His early studies on the pathology of liver cirrhosis and of beri-beri are widely quoted. During his directorship at the Government Institute for Infectious Diseases he attacked that baffling tsutsugamushi disease and finally established its etiology by discovering *Rickettsia orientalis*. His "Statistical Study of Cancer in Japan," published as a special number of *Gann*, is of permanent value. Studies he started on the brains of superior men in Japan produced morphological evidence that the brain of the Japanese is in no way inferior to that of the European.

The international aspect of Professor Nagayo's activity was wide and varied. In 1921 he went to Batavia, Java, as the Japanese representative to the Far Eastern Association of Tropical Medicine, of which association he was vice-president at the Tokyo Congress in 1925. In 1923 he was a member of the Japanese Medical Mission to the United States at the invitation of the Rockefeller Foundation. In 1928 he represented Japan at the Health Congress of the League of Nations (Geneva), the Congress for the Standardization of Serum (Copenhagen), the Leprosy Congress (Paris) and also the Cancer Congress (London). By request, he had served since 1933 as an advisory trustee to the International Cancer Research Foundation, Philadelphia, U. S. A. Professor Nagayo

spoke German and English well and made many friends in the countries he visited and won their trust and confidence. Eventually it became customary for all the distinguished medical men from foreign countries visiting Japan to visit Professor Nagayo, and they have gone away cherishing the kindest remembrance of his friendship and hospitality.

It is impossible to enumerate all the honors he received for his service to science and to his country. He was made a member of the Imperial Academy in 1936, and was elected an honorary member of the German Academy of Natural Science in Halle in 1939. When his condition was reported critical, H. I. M. the Emperor of Japan created him a peer with the title of Baron, and decorated him with the First Class Order of the Sacred Treasures.

A great leader has passed from us, but he has left a record of achievement that will be a source of inspiration to future generations, while to all who came in personal contact with him there remains a vivid memory of his truly distinguished personality.

WARO NAKAHARA

TOKYO, JAPAN

DEATHS AND MEMORIALS

DR. PAUL STILWELL MCKIBBEN, professor of anatomy and dean of the School of Medicine of the University of Southern California, died on November 12 in his fifty-sixth year.

DR. HUBERT VINTON CARPENTER, professor of mechanics and electrical engineering and dean of the College of Mechanical Arts and Engineering and director of the Engineering Experiment Station at Washington State College, died on November 15, at the age of sixty-six years.

DR. CARRIE M. DERICK, since 1929 emeritus professor of morphology, botany and genetics at McGill University, died on November 10 at the age of seventy-nine years. She joined the faculty as demonstrator of botany in 1891.

I. O. GRIFFITH, lecturer in mathematics and physics, since 1920 fellow of Brasenose College of the University of Oxford, died on September 22 at the age of sixty-one years.

To commemorate the one hundredth anniversary of the birth in 1841 of Dr. Eugene Allen Smith, who died in 1927 and who was for fifty-four years state geologist of Alabama, a meeting was held on November 1 in Smith Hall at the University of Alabama. Addresses were made by some of his old associates, and letters of appreciation from well-known geologists and mining engineers were read.

THE annual ceremonies commemorating the birth of Dr. Carlos Finlay, one of the investigators responsible for discovery of the transmission of yellow fever by mosquitoes, will be held in Havana early in December. The Ministry of Health of Cuba has announced that Vice-President Henry A. Wallace plans to be present at the ceremonies.

A FIVE-CENT stamp will be issued early in December to commemorate the work among the natives of Labrador and Newfoundland of Sir Wilfred Grenfell, who died on October 9, 1940.

SCIENTIFIC EVENTS

GIFTS AND BEQUESTS TO NEW YORK UNIVERSITY

IN the annual report of Dr. Harry Woodburn Chase, chancellor of New York University, it is reported that gifts and bequests to the university during the past academic year amount to $664,268. These include $60,282 from Bernard M. Baruch for the Samuel A. Brown professorship of therapeutics in the Medical College; $47,049 from the estate of Eugene Stevenson, as unrestricted endowment; $40,000 from the National Conservation Bureau for the Center for Safety Education; $39,105 from the Commonwealth Fund for medical research; $30,077 from the Sloan Foundation for the Educational Film Institute; $30,000 from the Hayden Foundation for scholarships and loans; $28,189 from the New York University Alumni Fund largely unrestricted, serving vital uses at many points not reached by the regular university budget; $26,286 from the Rockefeller Foundation for medical research and graduate teaching; $22,267 from the Carnegie Foundation for the Advancement of Teaching for retiring allowances; $18,036 from the estate of Emma Baker Kennedy for the Kennedy Endowment Fund; $15,386 from sundry donors for research in therapeutics; $10,400 from the Dazian Foundation for medical research; $10,400 from Lucius N. Littauer for research in the College of Medicine; $9,810 from the National Committee on Maternal Health for graduate research; $9,655 from sundry donors for research in pneumonia; $8,850 from Dr. F. H. Hirschland and others for graduate instruction; $7,500 from Marshall Field for the university's division of the Welfare Hospital; $7,500 from The John and Mary R. Markle Foundation for medical research; $7,491 from the Josiah Macy, Jr. Foundation for medical research; $6,878 from the Lederle Laboratories for medical research; $5,100 from Standard Brands, Incorporated, and Frederick M. Stern, for nutritional research.

THE NEW HALL OF ETHNOLOGY OF THE MUSEUM OF NEW MEXICO

The new Hall of Ethnology of the Museum of New Mexico at Santa Fe was opened for the summer on July 1. *Museum News* reports that until an appropriation can be obtained for an adequate heating system the building must be closed during the winter months. The exhibits in the main hall and the storage in the basement have been installed; work still remains to be done on the Hall of Man. In the main hall, or Hall of Ethnology, emphasis is placed on the cultural attainments of the Indians of the Southwest. Nine alcoves line the north, west and south walls with exhibits of jewelry, weaving, basketry, leather goods, ceremonial items, paintings, a room in a Pueblo dwelling, pottery and cradle boards. Each alcove has its own theme and an independent story to tell, so that no placards of direction are needed. The cases are designed so that they serve as boundaries of the alcoves. The lower section of each is a storage compartment; and this brings the base of the exhibition section to 29 inches above the floor. The display ranges to four feet above this height. Cases are 12 feet long, all without shelving. Installations are made from the front of the cases. Props of various shapes, made of celotex over wooden frames, are used to support specimens. It is planned to have Indian craftsmen working in the alcoves. In the space in the center of the hall is a relief map of New Mexico seven and a half feet square, constructed by WPA draftsmen under direction of the U. S. Forest Service, showing life zones, highways, routes of early explorers, towns, pueblos, monuments, parks, forests and other features. From this map extends a series of low cases with model groups illustrating the life of Indian groups that have been important in the history of the Southwest. At the west end of the hall is a set of four Navajo sand paintings, made in the orthodox fashion. In the basement Indian pottery is stored in a room on shelves so adjusted that the vessels could be arranged according to their place of manufacture and in the same relative position as actual Indian groups, beginning at the East with Taos and Picuris. The room is well lighted and provided with tables and chairs for those who wish to study the material. Basketry, textiles, leather, jewelry, ceremonial material and miscellaneous material are treated in a similar way. In the Hall of Man the basic principles of anthropology will be illustrated. There will be busts illustrating early man and racial groups; exhibits illustrating evolution of tools, art, etc.; and graphic material. The Hall of Ethnology is under the direction of Miss Bertha P. Dutton, with Ernest Halyvi, of Mishongnovi pueblo, in charge of the building for the season.

THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY AND THE HENRY R. TOWNE ENDOWMENT FUND

It is reported in the daily press that the trustees of the Henry R. Towne Endowment Fund have petitioned Surrogate James A. Foley for approval of their decision to discontinue payments of income to the Museum of Science and Industry and to distribute the remaining principal of $1,630,010 in equal shares between the Museum of Natural History and the Metropolitan Museum of Art.

Mr. Towne, who was head of the Yale and Towne Manufacturing Company, died in 1924. He left his residuary estate in trust for the purpose of establishing a museum of peaceful arts. The Museum of Science and Industry was named income beneficiary and as such has received $846,505 since the trust was established.

The trustees, John H. Towne, of Mount Kisco, N. Y., son of the decedent; Robert Struthers, Noroton, Conn., and the Bankers Trust Company, notified the income beneficiary on April 22 of their decision to discontinue payments to it and to distribute the principal, and the trustees have filed a final accounting, which they have asked the court to approve.

In his will Mr. Towne provided that

> if the trustees, after having given due consideration to conditions, management and prospects of the museums, the executors and trustees, unanimously decided that in their judgment (and their judgment herein is to be final) it is inexpedient for them to make any further provisions of the museums or unwise to make any further advance, gift or disposition of the fund or its income, they might in their discretion pay over the principal in equal shares to the Metropolitan Museum and The Museum of Natural History.

The Museum of Science and Industry has filed an answer and cross-petition in which it is stated that the decision of the trustees to discontinue payments to it violates the intention of the testator and constitutes an abuse of discretion, and is arbitrary and capricious, void and illegal.

In its cross-petition it points out that in the last five years it had exhibited scientific and industrial works of the kind contemplated by the testator having an aggregate value in excess of $3,000,000 to an average of more than 400,000 visitors a year.

The trustees in their report, which covers the period from November 26, 1929, to April 21, 1941, have accounted for a gross estate of $3,594,432. The principal at the beginning of the accounting period was $2,693,758. After payments to the income beneficiary, administration expenses and decreases, they had on hand on April 21 accounting a balance of $1,-

630,010. Surrogate Foley will hold a hearing in the proceeding in January.

THE NEW YORK MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE sixty-second annual meeting of the American Society of Mechanical Engineers will be held at the Hotel Astor, New York City, from December 1 to 5.

An extensive program has been prepared at which papers on the following subjects will be presented: Monday—vibration, power, work standardization, fuels. Tuesday—machine design, analysis of thin-walled structures, mathematical statistics, metals engineering, industrial instruments, power-hydraulic, boiler feedwater studies, mechanical properties of materials, machine shop practice, lubrication, heat transfer, national defense, aviation. Wednesday—plasticity, power session, textile, administrative organization, mechanical springs. Thursday—rubber and plastics, fluid mechanics, railroad, education and training, hydraulic, furnace-heat transmission, sugar, industrial marketing, materials handling, cutting of metals, marine power.

The annual dinner will be given on Wednesday at 6:30 P.M. William L. Batt will be toastmaster. Honors and medals will be presented to members and distinguished foreigners. The speakers will be William A. Hanley, president of the American Society of Mechanical Engineers and director of engineering of the Eli Lilly and Company, and Donald M. Nelson, executive director of the Seven Man Supply Priorities and Allocation Board. There will be a National Defense luncheon on Tuesday, a textile luncheon on Wednesday and a railroad luncheon on Thursday.

The sixth annual photographic exhibit is to be held as usual. This year it will be expanded to include all forms of graphic art, such as etching, pencil drawing, lithography, water colors, oil paintings, sculpture and so on. Medals of gold, silver and bronze will be awarded in all the various classes. The best photographs based on subject and reproduction possibilities will be used in *Mechanical Engineering*.

RESIGNATION OF DR. ROY CHAPMAN ANDREWS AS DIRECTOR OF THE AMERICAN MUSEUM OF NATURAL HISTORY

DR. ROY CHAPMAN ANDREWS, since 1935 director of the American Museum of Natural History, New York, presented his resignation at the annual fall meeting on November 11 of the board of trustees. His letter, addressed to Dr. F. Trubee Davison, president of the board, reads:

For thirty-five years I have been connected with the American Museum of Natural History. For twenty-eight years I carried on almost uninterrupted field exploration in various parts of the world. Seven years ago political conditions in China made it impossible to continue the Central Asiatic Expeditions in the Gobi Desert and upon the sudden illness of Dr. Sherwood, the director, I took over the administration of the museum.

The years that I was in the field were a period of expansion, the securing of invaluable collections and aggressive action for the museum in widely separated spheres. Chaotic world conditions have completely changed the picture. Even though funds were available it would not be possible to continue exploration except in a most limited degree.

As I see it, the museum, like many other institutions, is inevitably faced with a shift of emphasis in its activities. I have become the more convinced of this in conferences with Dr. Ruthven, who has been conducting the survey of the museum, which a year ago I requested the trustees to have made. The problems confronting the institution, particularly those dealing with its future financial requirements, are not those for which I am particularly fitted, either by inclination, temperament or training. I feel, therefore, that I am acting in the best interests of the institution when I ask the Board of Trustees to accept my resignation as director. I shall hope to maintain close relations with the museum and continue to serve it in other ways as long as I live.

THE AWARD OF MEDALS OF THE ROYAL SOCIETY

ACCORDING to a special cable to *The New York Times*, the King of England has approved the recommendations of the Council of the Royal Society awarding royal medals for the current year to Professor Edward Arthur Milne "for his researches on the atmospheres of the earth and sun, on the internal constitution of the stars and on the theory of relativity," and to Professor Ernest Laurence Kennaway "for his investigations on the production of cancer by synthetic substances."

Dr. Milne, since 1928 Rouse Ball professor of mathematics and fellow of Wadham College, Oxford, is the author of "Relativity, Gravitation and World Structure," which suggested a new approach to the theory of relativity. Dr. Ernest Laurence Kennaway is professor of experimental pathology at the University of London and director of the Chester Beatty Research Institute of the Royal Cancer Hospital, London. He was awarded the Baly Medal in 1937 for his work in biological chemistry and cancer.

Other medals will be awarded as follows:

The Copley Medal to Sir Thomas Lewis for experimental researches in clinic and laboratory on the heart and circulation and their disorders.

The Davy Medal to Dr. H. D. Dakin, of Scarborough, N. Y., for pioneer work in biochemical research and his contribution to the study of intermediate metabolism.

The Hughes Medal to Professor N. F. Mott for application of the principles of the quantum theory to many branches of physics, especially the field of nuclear collision theory, the theory of metals and the theory of photographic emulsion.

SCIENTIFIC NOTES AND NEWS

The Bailey K. Ashford Award of $1,000 and a bronze medal of the American Society of Tropical Medicine were presented at the St. Louis meeting to Dr. Lloyd E. Rozeboom, of the Johns Hopkins University, formerly medical entomologist of the Gorgas Memorial Laboratory at Ancon, the Canal Zone, in recognition of his work in tracing malaria transmission to a variety of mosquitoes suspected, but never demonstrated, to be a carrier of the disease.

The *Journal* of the American Medical Association reports that Dr. Arthur E. Guedel, Los Angeles, was the guest of honor at a dinner given on October 21 by the section on anesthesia of the Los Angeles County Medical Association to mark the presentation to him of the Hickman Medal by the Royal Society of Medicine, London. At the dinner a representative of the British Government made the presentation on behalf of the Royal Society of Medicine. The principal address was delivered by Dr. Chauncey D. Leake, professor of pharmacology, lecturer in medical history and bibliography and librarian of the Medical School of the University of California.

A dinner in honor of his sixtieth birthday was given by alumni to Dr. Champion H. Mathewson, professor of metallurgy and metallography and head of the department of metallurgy at Yale University. He was presented with a commemorative volume containing nineteen technical papers on physical metallurgy written by his former students.

Professor Fritz Hofmann, director of the Silesian Institute for Coal Research, has been awarded the Goethe Medal for Arts and Sciences in recognition of research work in connection with the production of synthetic rubber.

Dr. Elmer L. Sevringhaus, of the medical division of the Wisconsin General Hospital, University of Wisconsin, has been elected honorary foreign member of the National Academy of Medicine of Buenos Aires. Dr. Sevringhaus visited Buenos Aires last March and lectured there before the academy and other medical organizations as well as in Rosario and Montevideo.

At the last meeting of the New York City Branch of the American Society of Bacteriologists held at Columbia University on October 28, the following members were elected to hold office in 1942: *President,* Professor E. J. Keegan, St. John's University; *Vice-president,* Miss Mary Horton, Sheffield Farms; *Members of the council,* Dr. E. R. Eaton, Welfare Hospital, Dr. D. M. Rogers, Borden Farms, and Dr. W. Reiner-Deutsch, Triboro Laboratories, *chairman.*

George C. Thomas, Jr., president of the Thomas and Betts Company, Elizabeth, N. J., was elected at the New York meeting president of the National Electrical Manufacturers Association. He succeeds Earl O. Shreve, vice-president of the General Electric Company.

Dr. Millislav Demerec, who since 1923 has been a resident investigator at the department of genetics at Cold Spring Harbor, L. I., of the Carnegie Institution of Washington and who has served as assistant director of this department for the last six years, has been appointed acting director, to take the place of Dr. A. F. Blakeslee, who retires on December 1.

It is reported in the *News Edition* of the American Chemical Society that Dr. Fred C. Koch, who recently retired as Frank P. Hixon distinguished service professor of biochemistry at the University of Chicago, will continue his researches in the field of endocrines at the Armour Laboratories, Chicago, where he will also act as consultant on research problems in biochemistry. A newly completed laboratory has been designated the F. C. Koch Laboratory and set up for his use in the chemical research department of the institute.

A department of home economics research has been established at the Oklahoma College and Station with Dr. Williamina Armstrong, of the University of Illinois, as head. Dr. Armstrong will take over research in nutrition formerly conducted by Dr. Gladys Kinsman, who has resigned recently to become a member of the staff of the Women's College of the University of North Carolina at Greensboro. Research in home economics was previously administered under the department of agricultural chemistry research.

Appointments at the Michigan College of Mining and Technology include Chester Russell, formerly a department head at the Universities of New Mexico and Denver, associate professor of electrical engineering; J. M. Crockin, assistant professor, and Dr. M. W. Bredekamp, instructor in chemical engineering and chemistry; A. B. Epple, Robert Hagen and E. W. Niemi, instructors in mechanical engineering; R. B. Oliver, instructor in metallurgical engineering; Fernando Paciotti, assistant research engineer in mineral dressing.

Helmut R. R. Wakeham, of the Research and Development Department of the Standard Oil Company of California, has become associate chemist in the Section of Physical Chemistry of the Southern Regional Research Laboratory at New Orleans, La., of the U. S. Department of Agriculture.

C. FRED GURNHAM, a member of the department of chemical engineering of the Pratt Institute, Brooklyn, N. Y., has become associated with the firm of Fred S. Carver, New York City. He is conducting research on new applications of the operation of pressing, particularly in the field of vegetable fats and oils.

EDWARD GRAY, of the National Research Corporation, has been appointed biological chemist with Lever Brothers, Cambridge, Mass.

DR. A. EICHHORN, director of the Animal Disease Station at Beltsville, Md., recently visited England for consultations with the Ministry of Agriculture and the Agricultural Research Council.

DR. RICHARD S. BURINGTON, professor of mathematics at the Case School of Applied Science, has been granted leave of absence for the current academic year in order that he may continue his work as research mathematician and consultant in the Bureau of Ordnance of the Navy Department at Washington, D. C.

HENRY DYBAS, assistant in the Division of Insects of the Field Museum of Natural History, has returned to Chicago after collecting insects for three months in Mexico in company with Dr. Charles H. Seevers, of the department of zoology of the Central Y.M.C.A. College, and David Bergstrom. The party traveled by automobile and made stops of a few days or weeks at various localities which ranged from semi-arid country to luxurious tropical forest. Most of the collecting was done in the regions of Cordoba, Vera Cruz and the country to the south. The material obtained by Mr. Dybas numbers over 17,000 specimens. These are chiefly beetles, including three thousand fungus-dwelling beetles of the family *Ptiliidae*.

DR. VICTOR E. LEVINE, professor of biological chemistry and nutrition at the School of Medicine of Creighton University, has returned from the Arctic, where he spent the summer at King Island in the Bering Sea making vitamin C studies of Eskimo foods.

A GRANT of $5,000 has been made to the Vanderbilt University School of Medicine by the S. E. Massengill Company, Bristol, Tenn., to be used for experimental purposes in the field of menstrual disorders by Dr. John C. Burch, associate professor of obstetrics and gynecology.

DR. SETH B. NICHOLSON, astronomer at the Mount Wilson Observatory of the Carnegie Institution of Washington, delivered on October 29 at the University of California at Los Angeles the Alexander F. Morrison Lecture of the Astronomical Society of the Pacific. His subject was "Sunspots and Magnetism."

AT the meeting of the Philadelphia Section of the American Chemical Society, held on November 13 at the Franklin Institute, Dr. Colin G. Fink, head of the division of electrochemistry of Columbia University, gave an address on "Strategic Metals."

DR. THOMAS FRANCIS, JR., professor of epidemiology in the School of Public Health of the University of Michigan, will deliver on November 27 the second Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "Factors Conditioning Resistance to Epidemic Influenza."

DR. JAMES ALEX. MILLER inaugurated on November 13 the seventh series of the "Lectures to the Laity" of the New York Academy of Medicine with an address entitled "Tuberculosis: The Known and the Unknown." This constitutes the second Linsly R. Williams Memorial Lecture given in memory of Dr. Williams, who was the first director of the New York Academy of Medicine. A dinner to Dr. Miller preceded his delivery of the lecture. The Laity Lectures, six in number, are given one each month from November to May. They are open to the public and admission is free. Other lectures in the series are: December 11, "The Mechanisms of the Mind," by Dr. Tracy Jackson Putnam, professor of neurology and neurosurgery, Columbia University; January 22, "The Freudian Epoch," by Dr. A. A. Brill, lecturer in neurology and psychiatry, Columbia University (this is the New York Academy of Medicine Anniversary Discourse); February 26, "Creative Behavior in Child and Adult," by Dr. Arnold Gesell, director of the Clinic of Child Development, the School of Medicine, Yale University; March 26, "The History of Vitamin B," by Dr. Norman Jolliffe, associate professor of medicine, College of Medicine, New York University; April 23, "The Newer Knowledge on Nutrition," by Dr. A. J. Carlson, Frank P. Hixon distinguished professor of physiology, emeritus, University of Chicago.

AT the eighth annual post-graduate day of the Medical Institute of the University of Toledo on October 31, instead of the usual program of prepared papers, the conference method was used. The subjects under discussion were "Digitalis—New Light on an Old Drug," "The Management of Heart Failure," "Circulatory Stimulants and Shock." There were three outside speakers, all from the faculty of the Cornell University Medical College—Dr. Eugene F. DuBois, Dr. Harry Gold and Dr. McKeen Cattell. All three speakers appeared at each session, the last half of each period being devoted to discussion. The first part of the session in the evening was devoted to a memorial to the late Dr. Lyman A. Brewer, who had served as professor of surgery and dean of the

Toledo Medical College. He was chief of staff at the time of his death at the age of seventy-seven years on January 16, 1939.

THE Fourth South American Chemical Congress, sponsored by the Chilean Government, will be held at Santiago in January. At that time the University of Santiago will celebrate its founding in 1504.

THE forty-third annual meeting, the two hundred and forty-sixth regular meeting, of the American Physical Society will be held at Princeton University on December 29, 30 and 31. The preliminary arrangements for the program include a joint session with the American Association of Physics Teachers for Tuesday afternoon. At this session it is hoped that President G. W. Stewart, of the State University of Iowa, will deliver his retiring presidential address, that Professor W. F. Magie, of Princeton University, will speak on the life work of Joseph Henry, and that Professor Arthur H. Compton, of the University of Chicago, will deliver the first Richtmyer Memorial Lecture of the American Association of Physics Teachers on "Wartime Problems of the Physics Teacher."

THE sixth annual meeting of the Florida Academy of Sciences and the Florida Junior Academy of Sciences was held at Florida Southern College, Lakeland, on November 20, 21 and 22. In addition to the general sessions the academy met in three sections—Biological, Physical and Social Sciences. Sixty-one papers were presented. The program of the Junior Academy was held in the Lakeland High School building. Frank Brigham, superintendent of public instruction of Polk County, gave the address of welcome. There was a message from the Academy of Sciences, papers and demonstrations by members of the Junior Academy and a motion picture on vitamins in human nutrition by Professor L. L. Rusoff, of the university. Field trips, a football game and banquets for both academies were held.

PLANS for the construction by the General Electric Company of a plant to be built at a cost of $1,000,000 for the manufacture of synthetic phenol have been announced by William H. Milton, Jr., the newly appointed manager of the plastics department. The action was taken to counteract a shortage of phenol, used by the government for production of plastic parts. The new plant is expected to be in operation in 1942.

DISCUSSION

THE POLARIZATION OF ATMOSPHERIC HAZE

THE article by George M. Byram in SCIENCE for August 22, pp. 192–193, seems to require some amendments in view of research I have conducted in the field of atmospheric polarization.[1] The statement, that "when viewed through a combination polarizing screen and red filter, the visual range of distant objects may be considerably increased, because under favorable conditions this filter combination removes a large part of the atmospheric haze," must allude to the presence of a light-colored object in front of a dark background.

The visual range is a function of the contrast between the sighted object and its background. Disregarding the influence of color and form contrast and other physiological factors, there is still the contrast between the apparent brightness of the object and its background to be considered. The apparent brightness of the object consists of the light reflected by the object and the light scattered by the air and its suspensions between the observer and the object, the so-called air-light. With regard to the apparent brightness of the background, two possibilities are encountered: If the background consists of a solid object, as, *e.g.*, a mountain range, its apparent brightness is a function of light reflected on it and the air-light. In case wooded mountains (albedo 0.07) form the background to a light object, such as a light-colored smoke column, an improvement can be obtained by viewing through a red filter and polarizing screen, since the short-wave air-light which is partially polarized is absorbed and thus the contrast between the light object and its dark background is increased. The same holds true for white clouds which have blue sky for a background, as the combination filter greatly reduces the short-wave, partially polarized, sky-light and thus allows the white cloud to stand out much better in front of the dark appearing sky. In these cases the improvement is in visibility rather than in visual range.

The other possibility under consideration is a dark object with the light from the clear sky near the horizon, the so-called horizon-light, as a background. In this case the resulting conditions are entirely different. The apparent brightness of the dark object is mainly a function of the air-light. The horizon-light consists of the light scattered by the air column from the observer to the boundary of the optically effective atmosphere, tangent to the earth's surface at the point of observation.

The air column involved in the production of the horizon-light is necessarily longer than that producing

[1] *Arch. d. Deutsch. Seewarte*, 56: 6, 1–53, 1936.

the air-light in front of the dark object. Moreover, light scattered in higher layers of the atmosphere contributes a large part to the horizon-light, whereas the air-light in front of the dark object is produced in surface-near layers where relatively greater quantities of large depolarizing particles are present. Therefore the degree of polarization of the horizon-light must be greater than that of the air-light. This statement is implied in results obtained by C. Dorno,[2] who found that the difference between the polarization of the horizon-light and air-light increases with increase in distance from observer to object. Thus the combination of red filter and polarizing screen absorbs more of the horizon-light than of the air-light, lowering the contrast and decreasing the visual range.

Numerous visual and instrumental (Wigand's visual range meter) observations made by the author through combinations of colored filters and Nicol's prism under all possible weather conditions did not reveal any improvement of the visual range when the horizon-light formed the background to the sighted object. In no instance, not even under the most favorable conditions, could a dark object with the horizon-light as background be made visible by any combination of filters if the object was not visible to the unaided eye on account of haze (in the meteorological sense), fog or dust. F. Löhle[3] showed on a theoretical basis that the effectiveness of filters is bound to certain limits of the ratio (λ/r) of the wave-length (λ) to the prevailing radius (r) of the air particles. These limits within which an improvement of the visibility by means of filters can be expected are $1.03 < \lambda/r < 5$.

In the cases cited by Mr. Byram and those mentioned above where an improvement of the visibility is possible, the visual range is originally good. Therefore, the value of filters and polarizing screens for improvement of the visual range is negligible for all practical purposes.

If, however, the color contrast is of importance as, *e.g.*, in spotting certain objects on the ground from airplanes, the use of suitable filters may greatly facilitate the identification of these objects.

HANS NEUBERGER

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SOME EFFECTS OF BINOCULAR VISION

FOR some years I have amused myself from time to time with experiments in the stereoscopic effects obtained by viewing objects and the landscape from different positions—that is, from upright and recumbent positions of the head. I am not a student of optics and I feel fairly sure that I have made no observations that are not well known to specialists, but conversations with friends have led me to believe that some of these effects are not very generally known, and I have thought it might be worth while to call attention to them.

We are so used to viewing things in the round by means of our binocular vision that we seldom stop to wonder at the really wonderful fact that so short a distance as that between the pupils makes it possible to judge the distance of an object even when its size is unknown and to see distant objects in their spatial relations with one another. A change in the position of the head, however, may open our eyes, so to speak. If we look at things, not in the usual way, but with the eyes in a vertical line, one above the other, we get a very different view. Now the trunk of a tree, for instance, is perceptibly flattened in appearance, but the individual branches are seen in the round, and this has the effect of emphasizing their horizontal lines, so that we feel that we have never really seen them before. A very good tree to try this experiment with is the white pine (*Pinus Strobus*) because of its habit of growth. Lying on my side in some pasture and looking at the pines along its border, I see the beauty of their horizontal branches as I never can when standing. The beauty of a mountain landscape, too, can best be appreciated from the recumbent position. As all mountain-lovers know, the wide-stretching views owe much of their charm to the successive shades of green and blue that rise one above another to the horizon. Probably only an experiment for himself will convince any one that these horizontal zones of color take on an added beauty when seen from a horizontal position, but seeing is believing, and it is an experience that I have often had. This emphasis of the horizontal lines, however, involves a corresponding suppression of the vertical lines, so that, as might be expected, the landscape thus viewed is noticeably flattened, and the summits appear to be considerably lower. Nothing is added to the grandeur of a towering peak, therefore, by taking the recumbent view of it. Indeed, quite the contrary is the case. But the beauty of wide-spread views of ranges and valleys is strikingly enhanced by this change in the position of the head.

Another experiment may be tried on a nearby ridge or a pasture slope across a dip. When one lies down, the slope appears to be rounded vertically, and, if it is a compound slope, every change in the pitch is accentuated. On the other hand, when one sits up or stands, the conformation of the ascent opposite is unnoticed, but every change in the horizontal contour is accentuated. Thus, if there should be a little brook or brook-bed running down that opposite slope, its course and the form of its banks would show much more clearly than they did when the observer was

[2] C. Dorno, *Veröff. Preuss. Met. Inst.*, No. 303, p. 253. Berlin, 1919.

[3] F. Löhle, *Meteorol. Zeit.*, 55: 54–61, 1938.

lying down. If one looks at an evenly rounded hillock at a little distance, the horizontal convexity is evident when one's head is upright, and the vertical convexity shows itself when one lies down or holds the head sideways.

I have not exhausted the subject, but perhaps I have said enough to suggest to some readers a source of interesting and amusing personal experimentation.

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THE OBLIGATION OF THE UNIVERSITIES

The universities have, from all accounts, responded quickly and with a whole heart to the demands made upon them by the defense effort. In so doing they appear to have forgotten or to have disregarded their primary obligation to the community, as trustees of future leadership. With few exceptions, they have failed to insist upon deferment from military service of their graduate personnel, save in so far as such deferments are directly applicable to military defense. As a result, the personnel of those curricula from which immediate assistance is not needed is becoming seriously depleted. Many students of promise have been called into military service; others are shortly to be called; still others are transferring to departments in which deferment is likely to be had because of technological needs. The preservation of scientific research apart from its technological applications has seemingly received scant consideration. It is incumbent upon the universities to insist that this process of disintegration be halted before their primary function in the state is impaired, as it must be if deferment is not granted to promising candidates who would be expected presently to assume leadership and themselves direct the course of science.

We are faced with an emergency in more than a military sense. It is no longer a question of a year's service in a civilian peace-time army. It is now a question of the balance which must be struck between the various activities of the community as they affect our survival as a free people. It is a question of the intelligent direction and employment of human resources to achieve not only the military decision which we must achieve, but the utilization of it when the military effort is no longer needed. It is, I am convinced, now a question of the survival of science itself.

Science is an integrated whole. It is not physics and biology and chemistry. It transcends these disciplines and many more. It is a view of life and human effort based upon a continuous body of information which is being and must be constantly augmented. Its essence is the essence of democracy: of the free inquiry of individuals and the worth of individual judgments which are based upon observed and demonstrable fact. It is the very brain and nerve-center of our American civilization. Its antithesis is authoritarian dogma. It is a fragile fabric which depends upon warm human contacts from generation to generation. It can not be embalmed in printed words which later generations can discover in some tomb. It is a process, living and continuous, which rests not alone upon the research of a given master but upon the continued sharing of his experience and skills with the apprentice.

We are engaged in a struggle which is to determine whether our way of life and the scientific approach which is its base shall survive. The military effort is the present aspect of this struggle. In the long run it is not the decisive one. It can do no more than secure the ground over which a future more rational advance can be made. But it, no less than the non-military activities of the community, is finally dependent upon the resources and authority of science. Should army service be permitted seriously to deplete the oncoming personnel of science, particularly those to whom the universities and the community must look for leadership, its legitimate and mandatory activities will disappear and technology will wither at its source. We shall face the far-reaching consequences of a lost generation of leaders. The last war was won by a generation which was lost, and with their loss was lost the peace of Europe which it was their tragic responsibility to organize. To disorganize scientific research now is to place in jeopardy the military victory, to handicap it is to handicap the whole struggle for the community, both in prosecuting the war and in procuring the peace.

The community has invested heavily of its time and wealth in these young men in order to fit them for leadership in highly specialized and vital callings which few are equipped to undertake. I can not believe that the best interests of the community are to be served by deflecting exceptional students from the course upon which they have been set in order to make a transitory contribution which in many cases can be done more effectively by others of different temperament. Their specific knowledge and skills, continually augmented, may be of immediate and practical use in ways as yet unseen. The utility of scientific information is unpredictable. The curtailment of their training over any extended period will mean far more than the cessation of activities to be picked up again at the same point; a positive loss will inevitably have been incurred which it may be psychologically impossible to regain. The future effect of such loss upon both civil and military needs is incalculable.

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SPECIAL CORRESPONDENCE

PHYSICS IN PRE-NAZI GERMANY

GERMAN physics has occupied a prominent position in science during the last century. A big role in all the discoveries in the field of physics during the nineteenth century and the first quarter of the twentieth century was played by German physicists, particularly renowned among whom are Robert Mayer, Gustav Kirchhoff, Rudolph Klausius, Herman Helmholtz, the physicist, physiologist and physician, and Ludwig Boltsman.

Characteristic features of nineteenth century German physics were breadth of conception and the ability to solve major scientific problems.

The solution of these problems followed two trends. Albert Einstein elaborated his theory of relativity, the profundity and significance of which may be compared in the history of physics only with Newton's elaboration of the theory of mechanics. It was subsequently developed by other scientists, among whom we find the German mathematicians Minkovsky and Weil. On the other hand, we have the teaching of the structure of the atom—the smallest particle of matter—which was developed by both experimenters and theoreticians and which led to the elaboration of the famous quantum theory. At first this was the so-called old quantum theory in which the quantum principles were expressed in the simplest form. They proclaimed the necessity of regarding light, at one and the same time, as both a continuous substance and as an accumulation of discrete particles. For the scientists of those times who were not inclined to think dialectically this signified a revolution in their whole system of reasoning.

This theory was elaborated by Max Plank and Albert Einstein. In the following twenty years it was rapidly developed, at first in the work of the Danish physicist, Nilson Bohr, and the German physicist, Arnold Sommerfeld. It was then reconstructed anew and transformed into modern quantum mechanics (in point of fact, this marked the creation of a new science) by such famous physicists as Irvin Schredinger and Werner Heisenberg. This theory has entered the arsenal of modern technology and has led to numerous remarkable discoveries.

MODERN GERMAN PHYSICS

Theoretical physics is declared by the Nazis to be "Jewish physics." This meaningless combination of words is supposed, in the opinion of the crassly ignorant Unteroffiziers, to signify the harmfulness of science, while as far as the scientists of Germany are concerned a "veto"—complete and utter—has been placed on their fruitful work in this field.

There appears the disgraceful book by Philipp Lenard, "Germany and Jewish Physics," in which it is "explained" that German physics is created by "the German popular spirit which is unoverburdened with erudition."

The "principle" of the racial dependence of scientific knowledge, in accordance with which all correct scientific results belong only to Aryans, is taken seriously as the supreme criterion in judging one or another physical theory. This "principle" asserts that even the "conception of the fact that two times two is four takes on different hues in the minds of the German, the Frenchman, Negro and Jew (from an article in *Natur,* December 7, 1940).

With Hitler's advent to power Albert Einstein is described as follows: "The American Jew Michelson and the vile Jew Einstein received the Nobel prize from the Swedes, who have sold their race."

This citation is taken from the German magazine *Grenzland* of 1934, in which in a letter to K. Rosenberg "Doctor" Eric Roskote lists W. Heisenberg's sins before "Aryan physics."

Urban, "councillor of higher schools" came out with a reply to the letter, "explaining" that "Einstein's theory is pure dupery and has no other purpose than to befool Aryans."

The physicist I. Stork, the director of the Reich Institute of Physical Engineering, at the opening of the institute in Heidelberg, presented an equally authoritative characterization of theoretical physics—"Jewish physics" and its "high priest," A. Einstein. Stork proposed that the science chairs and the guidance of science be handed over to "the true German SS's of science" and that all the great physicists be driven out of Germany.

One after another the most prominent physicists left Germany. Some were hounded out of the country because of their race, others are demonstratively refusing chairs and flee before reprisals can be taken against them, as Dr. Frank did on the day that the Nazis seized power. Dr. Frank was professor of physics in the Göttingen University since 1920. At the present time he is working in Chicago (SCIENCE, Vol. 87, 456, 1938).

The renowned physicists Bloch, Boethe, Haitler, London, Paiphes, Plachek, Wigner and Weiskopf, known for their brilliant work on the application of quantum mechanics to various concrete physical problems, have been driven from Germany. Bloch elabo-

rated the principles of the theory of metals and explained a number of their properties. It was he, too, who explained a number of the properties of ferromagnetites. Bloch, Boethe and Haitler explained a number of the effects of the passage of rapid, charged particles through an element. Their work forms the foundation for the comprehension of all the phenomena taking place in the cosmic rays. Boethe and Paiphes are likewise known for their work on the theory of the atomic nucleus and on the physics of crystals. Haitler and London have explained the properties of chemical forces. Their work in this direction plays an important role in the study of the colossal amount of facts pertaining to chemical reactions. Plachek, Wigner and Weiskopf have worked up the theory of dispersion of light and have done important research in atomic nucleus physics.

The Aryan physicists—Heisenberg and Sommerfeld and others—who remained in Germany found themselves hounded. For recognizing modern science and especially for recognizing the "non-Aryan" theory of relativity, they were given the sobriquet of Weisse Juden. Sommerfeld was compelled to give up his chair in the University of München, where for over thirty years he had trained a brilliant group of young physicists.

As a result German physics lost its leading role in world science.

In Fascist Italy, too, the same thing took place. Fermi, the Nobel prize winner, fled from Italy; Bruno Rossi was expelled from the University of Padua by special decree in September, 1939. Rossetti, Segré and others likewise fled from their native land—Italy!

Before the advent of the Nazis the German physical journals (*Zeitschrift für Physik, Annalen der Physik, Physikalische Zeitschift*) had always served as the central organs of world science in this domain. The campaign of the Nazis against German science caused these journals to turn into meager notebooks frequently filled with third-rate work by the few physicists still remaining in Germany. The biggest of these journals, *Zeitschrift für Physik*, for instance, publishes two and one half issues a year instead of the six to seven issues it normally published in the 'twenties. In its time this journal attracted scientific papers from all over the world. In 1930 approximately 700 scientific papers were printed in its seven volumes, of which 280 were by foreign scientists (including about 80 by Soviet scientists). In 1938 only about 150 papers were printed, of which about 50 were by foreign authors. Thus this journal, once the central organ of world physics, has been transformed into a provincial journal. The following facts are very indicative. If we take the American journal *Physical Review*, which to this day serves as one of the most important scientific organs, and calculate the number of times German papers are cited in it we shall find that in 1932 about 35 per cent. of all the references referred to papers published in Germany. In 1939 only 15 per cent. of the references were to German papers, and even of these many pertained to papers written before the Nazis seized power.

The German physical journals are forced to publish such "scientific papers" as Stork's article: "The Structure of the Electron and Super-Conductivity." From the very first lines of this article it is obvious that the author tries to refute the modern theory of quantum mechanics. Although he asserts that the theory must be combined with experimental work he himself makes no attempt to base himself on modern experimental data.

Stork once received a Nobel prize in the past, but being connected with the ceramics industry it is many years since he has been working in the field of physics and he is therefore more than a quarter of a century behind modern physics. And it is Stork and Lenard who are Führers of "German physics."

Nazism has wreaked the same havoc with science in the territories which it has conquered.

An item in *Natur* (3711) points out that the dismissal of rectors and deans from the Czech universities by the German authorities shows that these universities, which have been closed for three years, will never be reopened.

In an article on German Kultur in Czecho-Slovakia *Natur* (No. 3706 of November 9, 1940) writes that the books and valuable appliances were removed from the Czech universities or simply squandered. The splendid equipment of the Institute of Physics in Poland also, as we know, met the same fate.

Correspondent in USSR

QUOTATIONS

THE NUTRITION SOCIETY

Elsewhere in this issue we publish particulars of the newly formed Nutrition Society. In giving it, as we do, a whole-hearted welcome, we are not to be taken as either assenting to or dissenting from any general proposition about the desirability of forming new scientific societies—even in peacetime. For such projects to be praiseworthy at least two conditions must be satisfied. First, the subject of the new society's activity must be of importance—as the patent lawyers might say, it must have "content"; secondly,

there must be no other existing society that can cover the whole of the same ground equally well. On the second issue the new society can claim general support. The scientific attack on nutrition is, indeed, made from many directions—by medical practitioners, biochemists and physiologists, agriculturists and veterinarians, dietitians and sociologists, economists, statisticians, food technologists and probably others. In the specialized organizations to which these various experts belong questions of nutrition will be discussed with less or greater frequency. Indeed, in medical organization the attention given to dietary factors is certainly still on the increase. But even here, and in the excellent meetings arranged through its Nutrition Panel by the Food Group of the Society of Chemical Industry, it is obvious that there is a lack of integration. At the medical gathering the biochemist and laboratory worker are likely to be in the background, the agronomist and the practical dietitian probably entirely absent; at the Food Group meetings medical views are unlikely to be represented, and veterinarians are probably as invisible as statisticians. If the new society can bring together all the contributors to our growing knowledge of the relationship between food and health it will certainly achieve something not yet achieved—primarily, perhaps, because it has never been attempted, at all events in this country. And it has so far not been attempted because the importance of the subject is still too little appreciated in many of the most influential circles. It is doubtful if the emphasis given to-day to problems of feeding the community would have been nearly as marked but for the exigencies of wartime. In this sense, but we are sure in no other, the Nutrition Society may possibly be considered a child of Hitler. There can be little doubt to-day—least of all in the minds of medical practitioners—that nutrition has become a subject with "content." For the investigations of nutritional problems, special and other new techniques have been increasingly needed; for the discussion of problems and techniques alike a new organization has been found necessary.

That there are many gaps—some of them enormous—in our knowledge of human and animal nutrition would not be denied by the most craft-conscious nutritional scientist. The meetings or conferences to be organized by the new society—if one may judge by the proposed Cambridge meeting on "The Evaluation of Nutritional Status"—are just of the type calculated to reveal these gaps and therefore to point to ways of closing them. In that sense, if in no other, the foundation of the Nutrition Society may legitimately be regarded as a contribution to the national war effort, for it can not fail to give support to all those forces that, by stimulating investigation and helping to disseminate its results, make for improvements in the dietary of the people as a whole and therefore in their health, their vigor and their democratic independence.—*The British Medical Journal.*

SCIENTIFIC BOOKS

THE HARVARD BOOKS ON ASTRONOMY

TWENTY years ago Harlow Shapley became the director of the Harvard College Observatory. A young man himself (then only 36), he chose other young men to work with him. As director he elected to delegate to the younger men responsibility for plans as well as for execution of the plans. He encouraged them to undertake research and found the money to support their projects. As the years have passed, he has brought to Harvard Observatory that air of critical, original thought, that intellectual ferment that can perhaps best be described as an "atmosphere of research."

Realizing the need for a series of modern authoritative books on the various fields of astronomy which might be read by laymen, beginning students and amateur astronomers, he set his men to work. Nine books were planned, and fourteen authors have been writing them. In each case, the authors were chosen because of their competence in the particular field. Serving as editors are Dr. Shapley and one of his young men, Dr. Bart J. Bok; this may be taken as a guarantee of the quality of the books. The Blakiston Company of Philadelphia is publishing the series.

The first four books of the series have appeared. If the later volumes maintain the high standard set by these four, the series will be an outstanding success. The volumes at hand are attractively bound in a red water-resisting material. Each has 200 or more pages of clear easily read print and excellent illustrations. Especially to be commended is the generous use of photographs of astronomers, past and present, each picture appearing near the point at which the man's work is mentioned in the text.

The progress of astronomy is so rapid that it is difficult to publish a book that is truly up-to-date. These volumes are! Furthermore, they are inexpensive and readable; they may be read with pleasure and profit by any person with a high-school education.

The Milky Way. By BART J. BOK and PRISCILLA F. BOK. 204 pp. 96 illustrations. Philadelphia: The Blakiston Company. 1941. $2.50.

This book presents clearly an excellent summary of our present knowledge of the Milky Way and explains how that information was gathered. It also points out some of the problems which remain to be solved. It explains how the astronomer interprets his star-counts and why international cooperation in the field is so important. The book is a very readable one, one interesting idea leading directly to another. As evidence that the book is up-to-date, mention might be made of the automatic star-counter of McCuskey and Scott, and the use as illustrations, of photographs taken with Schmidt cameras.

The reader may be misled by the modesty of the authors; the name, Bok, does not appear in the index and the personal pronouns, first person, seldom appear in the text. Their contributions to the field are mentioned but without credit to them or to Harvard Observatory. There should be some way of informing the reader that the Doctors Bok are authorities in the field in which they write. This comment applies also to the other three books reviewed here.

One can get a glimpse of the authors in their choice of words; colorful phrases, such as "Siberian wastes of intergalactic space," "ectoplasmic glow" and "leaking quantum" appear occasionally. Some persons will criticize the book because the term, "light year," is used on page 17 and defined on page 31; because "proper motion" is used on page 38 and explained on page 65. However, a second reading, which the book well deserves, will take care of such small difficulties. After reading on page 40, ". . . since light is a wave-motion . . ."; on page 112 of "light quanta" and on page 131 of a "qantum of wave length 3933, Angstroms," the reader may feel that the authors should have said specifically that astronomers are unable to choose between the wave theory and the quantum theory of light.

There is an index at the end of the book which is generally satisfactory. It may be noted that the important word, "parallax," does not appear there; under "stellar," one finds several kinds of parallax listed but not the basic "trigonometric parallax." In a small pocket in the back, there are two excellent composite photographic maps of the Milky Way, Northern and Southern, which may be removed for examination.

Between the Planets. By FLETCHER G. WATSON. 222 pp. 106 illustrations. Philadelphia: The Blakiston Company. 1941. $2.50.

This volume covers the asteroids, comets, meteors and meteorites and discusses briefly the zodiacal light and the Gegenschein. It is natural for an author to emphasize those things in which he is particularly interested; approximately one fifth of this book is about asteroids, one fifth about comets and three fifths about meteors and meteorites. It should appeal especially to statistically minded persons, for there are many graphs, scatter diagrams and tables. To be specific, there are about thirty tables, fifty charts, graphs and diagrams and sixty photographs or pictures.

Mathematicians will be critical of some of the statements appearing in the book, as, for example, on page 4, "Elliptical orbits can be of all shapes and sizes," and on page 6, "If it moves faster, the orbit is a hyperbola having an eccentricity larger than one and, according to the mathematicians, a period greater than infinity. . . ." Elliptical orbits are always closed curves and except for limiting cases, oval in shape; the mathematician's definition of "infinity" does not allow anything to be "greater than infinity." On page 53, the author uses the phrase, "moderately circular" and in the legend of Figure 40, page 72, "extremely circular." Circularity is somewhat like perfection; it is not subject to qualification.

One wonders why, after using good American phrases throughout the book, the author should choose to use "million million million" instead of "quintillion" or, if necessary, "American quintillion." The reader will be aware that the proofreading was poor. If the author had had an opportunity to correct a second proof, the book would have been improved. Fortunately, there are few places where scientific accuracy of statement is endangered by typographical errors.

When the reviewer was in college, he was not allowed to write two complete sentences and separate them merely by a comma. The author allows himself this privilege frequently. Investigation reveals that some of the most recent text-books on English allow such "run-on" sentences. Thus the English, as well as the information in this book, is the very latest.

After these critical comments, it may be wise to say again that the book will be interesting to any one wanting to know more about asteroids, comets, meteors and meteorites.

The Story of Variable Stars. By LEON CAMPBELL and LUIGI JACCHIA. 226 pp. 82 illustrations. Philadelphia: The Blakiston Company. 1941. $2.50.

This volume covers well the field of variable stars—discovery, observation and theory; short-period, long-period and irregular variables, novae and eclipsing

binaries. It is well written and reflects the authors' enthusiasm for their subject as well as their knowledge of it. The senior author has been a guiding light of the American Association of Variable Star Observers for many years. One may confidently predict that every member of this organization will want a copy of the book, as will other amateurs who are looking for observational work to do.

The authors stay close to the subject in hand, though on page 98, one is reminded of the difficulty of throwing a twelve with a pair of dice and on page 113, Samson and Delilah are introduced. It is pleasant to find specific figures given, as for example, the shortest and longest periods known for a given type of variable star. One is encouraged to learn on page 131 that it is improbable that our sun will explode, a possibility to which too much space has been given in our newspapers.

For a horizontal inflexion point, the authors use the word "still-stand," presumably because there is no better English word for it. They might have used the initial letters of "horizontal inflexion point," thereby giving a new and descriptive use to an old word. The characteristic curve of a photographic emulsion has a "toe" and a "shoulder"; why shouldn't an occasional light-curve of a variable star have "hips"?

At the end of the book are given the following tables: Names of the constellations and their abbreviations; Table for conversion of decimal of a day to hours and minutes; Julian Day Table 1940–1950; Twenty interesting variable stars; Fourteen interesting Novae.

Earth, Moon and Planets. By FRED L. WHIPPLE. 293 pp. 140 illustrations. Philadelphia: Blakiston Company. 1941. $2.50.

This lucid book has a freshness which is amazing when one considers the large number of books which have been written about the solar system. The field covered is adequately described by the title. One finds the true spirit of science in the impersonal manner in which the evidence bearing on a given theory is evaluated and in the breadth of mind reflected in the phrasing of conclusions drawn from that evidence.

Every chapter in the book is interesting, but the discussions of "The Earth as an Abode of Life" and of Mars are of especial interest. In contrast to the other three books reviewed above, metric units are not used, nor is temperature given on the Centigrade scale. The average American reader will find miles and degrees Fahrenheit easier to understand than kilometers and degrees Centigrade. One can read this book with pleasure and understanding, even though one has no scientific background.

Some readers will dislike the use of many footnotes; the presence of a dagger or an asterisk at the end of a sentence does interrupt the smooth continuity of a paragraph. Others may take exception to the spelling of some words, such as "clews" and "crape," and to the use of "island universe" for a spiral nebula. Those making the latter criticism will insist that though "island universe" has been widely used, by definition there is only one universe and it includes the spiral nebulae.

In a small pocket in the back of the book, there is a good star-map covering the region of the sky within 65 degrees of the celestial equator. This is convenient since one does not need to take the whole book out into the garden when one wishes to study the stars. No maps are given for the regions near the celestial poles. One unusually valuable feature of this book is the Planet Finder, with which one can determine the approximate locations in the sky of the Sun, Mercury, Venus, Mars, Jupiter and Saturn at any time between 1940 and 1970, inclusive.

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CALCULUS OF EXTENSION

The Calculus of Extension. By HENRY GEORGE FORDER. xvi + 490 pp. Cambridge: At the University Press. New York: The Macmillan Company. 1941. $6.75.

THIS book gives an account of the use of Grassmann's Calculus of Extension in geometry. The abstract algebra, which is The Calculus of Extension, is developed postulationally and is applied in a variety of geometric situations.

The treatment advances from the special to the more general. Chapter I is devoted to "Plane Geometry," and Chapter II to "Geometry in Space." Chapter III is concerned with "Applications to Projective Geometry," and "The General Theory" begins with Chapter VII. In all there are fifteen chapters treating among others such further topics as "Rotors in Space, the Screw, and the Linear Complex" in Chapter IV, "Circles" in Chapter XI, and "Transformations and Square Matrices with Applications to Central Quadrics" in Chapter IX.

Much of the material included is classic. However, a characteristic of this work which is due to the author is the emphasis on identities. His aim is "to express geometric theorems as identities, involving not coordinates but the geometric entities themselves which appear in the theorems."

The author is professor of mathematics in University College, Auckland, New Zealand. He comments in the Preface upon the unfavorableness of his environment to scholarly endeavor, noting particularly

a dearth of good mathematical libraries. It would seem that this book which he has written is especially well adapted to the needs of students where a good mathematical library is not readily accessible. To master this volume would imply an algebraic and geometric education of no mean order. However, if the author had been writing in the United States, where students acquire in courses in higher algebra a reasonably good mastery of this subject, he might have been disposed to devote less space to certain algebraic subjects, for example, "The General Theory of Matrices," to which Chapter XIII is devoted.

In writing this book the author has served the cause of geometry well. Students of geometry wherever English is spoken will find this a practicable reference for the topics discussed and the method employed. The author has succeeded in his purpose "to show the algebra at work, to illustrate its power and its range."

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SOCIETIES AND MEETINGS

THE SECTION OF PSYCHOLOGY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION I (Psychology) of the American Association for the Advancement of Science will meet in Dallas, Texas, on Monday, December 29, and Tuesday, December 30, as part of the general meeting of the American Association for the Advancement of Science which extends from December 29 through January 3.

In addition to the usual program of contributed papers there will be, on Monday, December 29, a symposium on "Recent Advances in the Appraisal of Personality" under the chairmanship of Professor Ernest R. Hilgard, of Stanford University, and on Tuesday, December 30, a joint symposium with Section Q (Education) on "The Psychology of Learning and the Educative Process."

It is hoped that a large number of psychologists will attend and participate in the Dallas meetings. The character of the general program must depend on the submitted papers, and all psychologists are urged to send in abstracts. Both theoretical and experimental papers are acceptable.

Psychologists who wish to read papers should submit abstracts in duplicate (not more than 300 words in length). Please note on the abstract the time required for presentation up to a limit of 15 minutes, and also whether a slide projector or moving picture projector will be required. Abstracts should be sent to the Chairman of the Program Committee, Professor John A. McGeoch, Department of Psychology, State University of Iowa, Iowa City, Iowa, so that they will be received not later than November 15, 1941.

The meetings of Section I of the American Association for the Advancement of Science offer to psychologists not only an opportunity to participate in meetings of their own, but also to become acquainted with current investigations and investigators in other sciences. The activities of Section I can do a great deal toward establishing the place of psychology among the sciences, toward cementing friendly relations with related sciences, and toward increasing the influence and usefulness of psychology. It is hoped that many among the members and associates of the American Psychological Association who are not now members of the American Association for the Advancement of Science, and through it of Section I, will join the American Association for the Advancement of Science and participate in its meetings. By so doing they will be supporting the advancement of science in general and of psychology in particular. The secretary of Section I will be happy to receive and endorse applications of members and associates of the American Psychological Association, and to answer questions concerning the work of Section I.

ARTHUR W. MELTON, *Secretary*
UNIVERSITY OF MISSOURI

SPECIAL ARTICLES

PURIFICATION OF THE VIRUS OF MOUSE ENCEPHALOMYELITIS (THEILER'S VIRUS)[1]

BEARD and his collaborators[2] were able to purify the virus of equine encephalomyelitis and that of rabbit papilloma by differential centrifugation of infected tissue extracts. Working with encephalomyelitis virus in chick embryos, they observed, however, serious disturbances of the purification process, unless the brain and chord were removed from the embryos before preparation of the extracts.

The study on the virus of mouse encephalomyelitis to be reported here was made with the highly virulent FA strain of the virus.[3] Infected mouse brains served

[1] This study was made with the aid of a grant from the King of Sweden's Birthday Fund for Prevention of Disabling Diseases.

[2] H. Findelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Inf. Dis.*, 66: 117, 1940; and J. W. Beard, W. R. Bryan and W. G. Wyckoff, *Jour. Inf. Dis.*, 65: 43, 1939.

[3] M. Theiler and S. Gard, *Jour. Exp. Med.*, 72: 49, 1940.

as starting material, and the difficulties mentioned by Beard were very obvious. The large quantities of slowly sedimenting, coarse material (cellular structural elements rich in lipoids and lipoproteins) present in the extracts rendered purification by means of differential centrifugation impossible. Attempts to obtain more suitable solutions through digestion with pancreatic juice were not successful. The purification procedure, finally adopted, was as follows.

Five hundred mouse brains are ground with sand and 0.05 M sodium chloride solution is added to make a total volume of 3,500 ml. The coarse material is allowed to settle overnight in the cold room. The supernatant extract is then siphoned off and vigorously shaken with two thirds by volume of ether. The mixture forms an emulsion, which, however, soon separates into two distinct layers, an aqueous one containing practically all the original activity and an ethereal top layer, in which most of the lipoids are to be found. The bottom layer is collected and one half by volume of saturated ammonium sulfate is added. A voluminous precipitate, containing more than 99 per cent. of the activity, is formed, rapidly rising to the surface. This precipitate is collected, washed in a separatory funnel with one third saturated ammonium sulfate solution, and finally extracted with distilled water. It is important that the ether should not be removed until the extraction is completed, otherwise the lipoids, still present in the precipitate, will be emulsified and the extract thus be unsuitable for further purification. The aqueous extract, faintly yellow in color and almost clear, is concentrated by means of ultrafiltration as described by Seibert,[4] washed on the filter with distilled water until free from salt and ether, and finally fractionated in an air-driven high-speed quantity centrifuge at 11,000 and 22,000 r.p.m. After 3 to 4 fractionations the solution is usually free from fast sedimenting material, and gives by centrifugation for 2 hours at 22,000 r.p.m. a small pellet, homogeneous, yellowish brown and readily soluble in distilled water. If optical methods are to be applied in the further analysis, the final volume of the preparation should not exceed 1 ml. All operations indicated above should be performed at a temperature below 8° C.

The preparations, purified according to this method, retained 30 to 50 per cent. of the original activity, corresponding to an increase in activity per unit of volume of about 1,000 times. The sedimentation constant of the virus was determined in two ways.[5] By optical analysis of purified material in the ultracentrifuge three components could be distinguished with sedimentation constants s_{20} of about 40, 160 and 210×10^{-13}. In similarly treated normal mouse brain only two of these were present and no traces of the middle component with the sedimentation constant $s_{20} = 160$ could be detected. In the active preparations the concentrations of the three components were nearly equal, corresponding to about 0.5 mg per 100 g of mouse brain.

Furthermore, crude extracts as well as partially purified material were spun in the separation cell[6] and activity determinations performed on the contents of the outer and inner compartment. The sedimentation constant was calculated to be 160 to 170×10^{-13}. It seems, therefore, highly probable that the medium component, present in active material only, really represents the virus protein.

On one preparation, consisting of the virus component in practically pure state, a determination of the diffusion constant was attempted. The accuracy of the value observed, $D_{20} = 0.27 - 0.33 \times 10^{-7}$, must be regarded as somewhat questionable on account of the small quantity of material available. On the assumption of a specific gravity of 1.33 the diffusion constant 0.30 corresponds to a molecular weight of 52×10^6. If one further assumes ellipsoidal and unhydrated molecules, the axial ratio can be calculated to be 46:1 and the actual size 640×14 mμ. Beard and his collaborators[7] found, however, in another neurotropic virus, that of equine encephalomyelitis, a large proportion of lipoids and a correspondingly low specific gravity of 1.19. On the basis of this latter value the figures in the case of mouse encephalomyelitis virus would be $M = 81 \times 10^6$, the axial ratio 31:1 and the size 590×19 mμ. In all figures given above the error might amount to ± 20 per cent. For comparison it might be mentioned, that Theiler and Gard by means of ultrafiltration determined the particle diameter to be 9 to 13 mμ.

The observation by Armstrong[8] of murine strains of the virus of human poliomyelitis has augmented the importance of the study of that of mouse encephalomyelitis and its possible relationships to the human virus. The results reported here, seem to indicate new ways for approaching this problem. A study along these lines has been started, the results of which will be published elsewhere.

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[4] F. B. Seibert, *Jour. Biol. Chem.*, 78: 345, 1928.

[5] Sedimentation and diffusion experiments were always carried out at 0° C. and the constants corrected as usual.

[6] A. Tiselius, K. O. Pedersen and T. Svedberg, *Nature*, 140: 848, 1937.

[7] D. G. Sharp, A. R. Taylor, D. Beard, H. Finkelstein and J. W. Beard, SCIENCE, 92: 359, 1940.

[8] C. Armstrong, *Pub. Health Rep.*, 54: 1719, 1939; C. W. Jungeblut and M. Sanders, *Jour. Exp. Med.*, 72: 407, 1940.

THE CARCINOGENIC EFFECT OF METHYLCHOLANTHRENE AND OF TAR ON RABBIT PAPILLOMAS DUE TO A VIRUS[1]

WESTERN cottontail rabbits frequently carry on the skin large epidermal papillomas caused by a virus,[2] which have the immediate character of neoplasms.[3] The growths closely resemble in structure and behavior the papillomas of unknown cause which are elicited on rabbit skin by tar and methylcholanthrene,[4] and after growing for a while they sometimes become carcinomatous,[5] as do these latter, undergoing histological changes of the same sort then, with result in malignant tumors of like kind. As bearing on the theoretical possibilities, it has seemed desirable to learn whether chemical carcinogens will cause virus papillomas to become cancerous.[6]

Two groups of domestic rabbits were inoculated with papilloma virus from different sources by rubbing it into four to six scarified areas of skin; and as soon as healing had taken place tar and 0.3 per cent. methylcholanthrene[7] were applied to some of the inoculated areas, while others on the same animals were painted with the solvent as such, or with a mixture in equal parts of turpentine and acetone which had been previously tested and found mildly irritant and non-carcinogenic for normal rabbit skin.[8] Untreated papillomatous areas served as further controls. The applications were repeated thrice weekly and were kept up for 2 to 4½ months, with stripping away from time to time of the keratinized layer overlying all the growths. Fifteen rabbits survived to the end of the tests. In no instance did cancer develop from the untreated papillomas or from those receiving ether and paraffin oil or turpentine and acetone, though this last mixture induced notably vigorous proliferation of the growths. In contrast with these results, malignant changes not infrequently occurred in the papillomas to which tar was applied, and they took place regularly and with unprecedented rapidity in those receiving methylcholanthrene. Under the influence of this last numerous cancers often arose in a single papillomatous mass, and some had exceeded a centimeter in diameter by the 63rd day after virus inoculation, that is to say, by the 55th day after papillomas had first become visible in the gross. In one instance a metastasis 1.2 cm in diameter was found in a regional lymph node on the 71st day. Sections of it disclosed squamous cell carcinomatosis like that already present at several spots amidst the papillomatous masses treated with tar and methylcholanthrene.

The cancers derived directly from the virus-infected cells, as do those which arise eventually in the ordinary course of events. Any interference which stimulates these cells may hasten malignancy[5]—a fact which holds true of tar papillomas also.[4] The question comes up of whether the chemical carcinogens did not act in this non-specific way in the present experiments; for they induced a more vigorous proliferation than occurred in the control growths. But highly effective non-specific stimulation falls far short of methylcholanthrene in bringing on malignant changes. During several years we have subjected virus papillomas to various stimulative procedures with the aim of procuring cancers as soon as possible, but have never succeeded in reducing the interval between inoculation and cancer to less than 4 months, and usually it has amounted to several months more. The repeated injection under papillomas of Scharlach R in olive oil, a non-carcinogenic mixture as the experience of many workers has shown, results in extraordinarily exuberant proliferation, and the appearance of cancer is often hastened, though not nearly so much as in the present experiments in which stimulation was less pronounced. The tar brought on fewer cancers than did methylcholanthrene, a finding which accords with the known carcinogenic effectiveness of the two agents.[9] These had been applied, not only to the virus papillomas but to the skin of the animals, and here by the end of the tests they had frequently evoked benign tumors of the sorts they usually call forth.

Of the known factors concerned in the production of the cancers the virus was obviously the most responsible and effective. Methylcholanthrene as such, when applied to the skin of domestic rabbits, does not give rise to visible papillomas for nearly two months at least—a fact exemplified in the present animals—and usually they do not appear until much later, while

[1] Work done with the aid of a fund from the Staff of Public School No. 158, Borough of Brooklyn, New York City.

[2] R. E. Shope, *Jour. Exp. Med.*, 58: 607, 1933.

[3] P. Rous and J. W. Beard, *Jour. Exp. Med.*, 60: 701, 723, 741, 1934.

[4] P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 69: 399, 1939.

[5] P. Rous, J. W. Beard and J. G. Kidd, *Jour. Exp. Med.*, 64: 401, 1936.

[6] Green has injected methylcholanthrene under virus papillomas with negative results (H. N. Green, Report of the Yorkshire Council of the British Empire Cancer Campaign, Hunters Armley, Ltd., Leeds, 1940–41, 13).

[7] The methylcholanthrene (Eastman Kodak Company) was dissolved in ether containing 2 per cent. of mineral oil. For some of the tests the tar was diluted with this solvent in a 1 in 10 proportion. It came from the Ostergasfabrik of Amsterdam—a gift from Dr. Karl Landsteiner.

[8] P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 73: 365, 1941.

[9] J. W. Cook, G. A. D. Haslewood, C. L. Hewett, I. Hieger, E. L. Kennaway and W. V. Mayneord, *Am. Jour. Cancer*, 29: 219, 1937.

cancer supervenes only after 9 months to 2 years, and infrequently then.[10] The tar we employed sometimes elicits papillomas after a few weeks, being stimulative as well as oncogenic,[4] but cancer is a very late and rare occurrence. The virus, in contrast, causes papillomas at once, and if nothing further be done and the growths prosper (for some retrogress), they nearly always become cancerous after 6 months to a year. The chemical carcinogens hurried along a process which would have occurred anyhow.

The skin papillomas and cancers of unknown cause which are evoked by tar and benzpyrene undergo singular alterations when they are experimentally infected with the papilloma virus.[11] Most of the papillomas suddenly begin to grow with great rapidity, and many of them alter histologically in ways more or less clearly indicative of the presence of the virus, with result in widely diversified, papillomatous neoplasms. Not a few of the tar papillomas which were previously benign, and which would have disappeared if let alone, change at once to squamous cell carcinomas; and tumors which were of the latter sort at time of infection may suddenly start to grow very fast and undergo cytological changes referable to the virus. Evidently the actuating cause or causes for the tumors evoked by the chemical carcinogens works in concert with the virus to cause these phenomena. The question arises of whether a similar joint action, with the association occurring in reverse order, may not have been responsible for the present findings. The facts give no support to this hypothesis. The application of tar and methylcholanthrene to the virus-infected cells did not result in the highly diversified and rapidly growing papillomatous neoplasms mentioned above, and such cancers as arose wholly resembled those ordinarily developing, in histology and behavior.

It seemed possible that the virus might have exerted so dominating an influence upon the cells with which it was already associated as to obscure the effects of any superimposed neoplastic changes referable to the carcinogens. The changes produced by the latter in the uninfected epidermis of the test rabbits assume importance in this relation; for the response of rabbit skin to the chemical carcinogens, as expressed in growths elicited, varies widely from animal to animal, and the local findings provide an index to the general potentialities of the tissue.

To learn the responsiveness of the skin of our rabbits the carcinogens were applied to areas situated immediately next virus papillomas that were similarly treated, or opposite them on the other side of the belly. The range of response proved great, many tar and methylcholanthrene papillomas developing on the skin of some of the animals after relatively brief exposure to the carcinogens, while in other cases none appeared throughout the period of the applications. The happenings in the virus papillomas varied independently of the cutaneous phenomena. Some of the rabbits which had most cancers developing from the virus-infected epidermal cells were nearly or quite free from skin tumors due to tar or methylcholanthrene, whereas the animal in which cancer appeared last of all, and then at one spot only, had skin notably responsive to the chemical carcinogens, numerous papillomas arising early where they were painted on. These results, like the character of the growths arising from the virus papillomas, speak against the possibility that the chemical carcinogens acted by bringing about neoplastic changes additional to those which the virus-infected cells would have undergone in the ordinary course of events.

The influence of many carcinogens, even those of widely differing character (as, *e.g.*, ultraviolet light and methylcholanthrene, beta radiation and benzpyrene), can be combined or summated; and within limits one such agent can often be substituted for another with result in tumors of the usual sorts. Conceivably the malignant alterations in the virus papillomas were due to some such process, the chemical carcinogens and the virus acting in a similar way, and together, to elicit cancers due intrinsically to neither of them. One would have to suppose, though, that the epidermal cells infected with the virus were so altered thereby that those least responsive to the influence of tar and methylcholanthrene under ordinary circumstances were now often markedly susceptible and *vice versa*.

The role of the virus in the carcinogenesis remains to be considered. It impelled the cells to a lively neoplastic proliferation throughout the period while tar and methylcholanthrene were applied to them, and many of the derivative cancers had a histology[4] which indicated its continued morphological influence. The possibility has to be thought upon that the chemical carcinogens acted by influencing the virus, either directly or through induced pathological alterations in the cells which are its milieu and medium of expression. Many facts point to virus variation as the cause for the changes in cell behavior and morphology occurring when cancers arise spontaneously from virus papillomas.[12]

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[10] Unpublished personal experience.

[11] P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 67: 399, 1938; *ibid.*, 68: 529, 1938; *ibid.*, 71: 787, 1940; A. Lacassagne and W. Nyka, *Bull. Assn. franc. étude cancer*, 26: 154, 1937; J. McIntosh, *17th Ann. Rep. Brit. Empire Cancer Campaign*, London, 1940, 44.

[12] J. G. Kidd and P. Rous, *Jour. Exp. Med.*, 71: 469, 1940.

POLYPHENOLASE ACTIVITY AS A PRIMARY CAUSE IN DARKENING OF BOILED POTATOES[1]

IT has recently been reported[2] that a compound (or compounds) reacting like catechol (orthodihydroxy phenol) occurs in potatoes during winter storage in proportions which show general correlation with the degree of blackening after boiling. Following that work we have investigated the activity of the polyphenolase system in tubers covering a wide range of discoloration after cooking. The difference in this function, as between normal and seriously discoloring potatoes, is much more definite than that found for the catechol reaction. As the polyphenolase system is much more active in the oxidation of catechol than of tyrosine, it appears that compounds of the latter type may not accumulate in proportion to the capacity of the tuber for discoloration. Our results thus indicate that departure from the normal respiratory relations after harvesting is a primary cause in darkening of boiled potatoes. A more extensive account of this work will be published soon.

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[1] Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. Supported in part by grants from the Wisconsin Alumni Research Foundation and done under the auspices of the University of Wisconsin Works Progress Administration Natural Science Research Program.

[2] C. O. Clagett and W. E. Tottingham, *Jour. Agr. Research*, 62: 349, 1941.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A COLORIMETRIC TEST FOR VITAMIN K_1

DAM *et al.*[1] while working on the isolation of vitamin K discovered that the isolated purified material gave, in the presence of sodium alcoholate, a violet blue color, changing to red and eventually to brown. Subsequently, both vitamins, K_1 and K_2, were found to give this reaction.[2, 3, 4] As far as it can be ascertained there has been no further report on the development of this test.

Sullivan and Irreverre[5] have shown that 1,4-naphthoquinone-2 potassium sulfonate is a highly specific reagent for creatinine. Since vitamins K_1 and K_2 are derivatives of α-naphthoquinone it was thought that perhaps there might be a compound in the creatinine group that would give a color reaction with vitamin K, particularly the naturally occurring K_1 and K_2. No such reaction could be obtained by any of the derivatives of creatinine at our disposal. However, on experimenting with vitamin K_1 and compounds belonging to the carbamic acid series, it was found that vitamin K_1 and 2,3-dimethyl-1,4-naphthoquinone gave a cobalt blue color in the presence of sodium diethyl dithiocarbamate and alkali, or better alcoholic alkali.

The test is performed as follows: To 2 cc of a 95 per cent. alcohol solution of the material to be tested, add 2 cc of 5 per cent. sodium diethyl dithiocarbamate[6] in 95 per cent. alcohol and 1 cc of alcoholic alkali (made by dissolving 2 gm of sodium in 100 cc of 95 per cent. ethyl alcohol). Under this condition vitamin K_1 (0.5 mg per 2 cc) gives a deep cobalt blue color attaining its highest intensity in 5 minutes and fading slowly after 8 minutes. At the end of 30 minutes the color is faintly reddish orange. This reaction was tried on a number of quinones: 2-methyl-1,4-naphthoquinone[7]; 2-chlor-1,4-naphthoquinone; 2-amino-1,4-naphthoquinone; 2-hydroxy-1,4-naphthoquinone; 2,5-dimethyl-1,-4-naphthoquinone[8]; 2,6-dimethyl-1,4-naphthoquinone[8]; 2,7-dimethyl-1,4-naphthoquinone[8]; 2,8-dimethyl-1,4-naphthoquinone[8]; 2,6-dimethyl-3-hydroxy-1,4-naphthoquinone[8]; 1,4-naphthoquinone; 2,3-dichlor-1,4-naphthoquinone; 2-methyl-3-hydroxy-1,4-naphthoquinone[7]; 1,2-naphthoquinone; 3-methyl-2,3-oxido-1,4-naphthoquinone[7]; 1,4-naphthoquinone-2,3-oxide. All the compounds enumerated gave a color: pink, red, green, brown or violet. The cobalt blue color, however, was exhibited only by vitamin K_1 and 2,3-dimethyl-1,4-naphthoquinone.[7] It is believed that the cobalt blue color is characteristic of 2,3-dialkyl substituted α-naphthoquinones in the α-naphthoquinone series, since the 2,3-dichlor-1,4-naphthoquinone gave a brownish violet color. Vitamin K_2 was not on hand. All the hydroxy derivatives gave red colors. The Dam *et al.*[1] test was also tried on all the substances mentioned, as follows[9]: To 4 cc of a 95 per cent. alcohol solution of the material to be tested, add 1 cc of alcoholic alkali (made by dissolving 2 gm of sodium in 100 cc of 95 per cent. ethyl alcohol). In our hands all the substances tested gave a color: yellow, orange,

[1] H. Dam, A. Geiger, J. Glavind, P. Karrer, W. Karrer, E. Rothschild and H. Salomon, *Helv. Chim. Acta*, 22: 310, 1939.

[2] P. Karrer, *Helv. Chim. Acta*, 22: 1146, 1939.

[3] L. F. Fieser, *Jour. Am. Chem. Soc.*, 61: 2559, 3467, 1939.

[4] A. A. Klose and H. J. Almquist, *Jour. Biol. Chem.*, 132: 469, 1940.

[5] M. X. Sullivan and F. Irreverre, *Jour. Biol. Chem.*, 128: ci, 1939.

[6] The sodium diethyl dithiocarbamate can be obtained from Eastman Kodak Company. If the substance is not pure it should be recrystallized from warm 95% alcohol with decolorization by carboraffin. A 5% solution of the colorless purified material in 95% alcohol should be practically colorless. This reagent must be freshly made and will keep for only a day.

[7] These compounds were furnished through the courtesy of Merck and Co., Inc.

[8] These naphthoquinones were kindly supplied by Dr. Louis F. Fieser.

[9] Dam *et al.* do not give any details for running their test.

red or green, while vitamin K_1 and 2-amino-1,4-naphthoquinone gave different shades of violet. The Dam *et al.* test was not found to be quantitative.

The sodium diethyl dithiocarbamate test is sensitive to 0.01 mg vitamin K_1 per 2 cc of 95 per cent. alcohol of 5 gamma per cc. With the use of a Klett-Summerson photoelectric colorimeter and No. 54 green filter this reaction is practically quantitative for vitamin K_1 in pure solution, from a range of 0.01 mg per 2 cc to 1.0 mg per 2 cc. Since the color is stable only for a few minutes the colorimetric readings must be taken every minute for 10 minutes immediately following the addition of the last reagent. The highest reading is then used. Example: 0.1 mg K_1 gives the highest reading of 60 in 5 minutes, while 0.05 mg reads 30, the highest in 5 minutes. The reading of 30 is just half of 60, while 0.05 is half of 0.1. The stability of the color changes with respect to concentration. At lower concentration the color is more stable than at the higher ones. This reaction of sodium diethyl dithiocarbamate and alcoholic alkali with vitamin K_1 gives a color five-fold that of the Dam *et al.* The use of absolute alcohol as solvent for standards and reagents in both tests has practically no advantage over 95 per cent. ethyl alcohol.

The reaction of vitamin K_1 with sodium diethyl dithiocarbamate and alcoholic alkali is far more sensitive than that of Dam *et al.* and has the additional advantage in that it can be used quantitatively.

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CONCENTRATION OF ENZYMES AND OTHER BIOLOGICAL COLLOIDS BY DIALYSIS

It is sometimes desirable to reduce the volume of a tissue extract or biological fluid containing desired enzymes or proteins, yet to avoid the denaturation which occurs more or less during concentration processes such as evaporation by use of mild heat, distillation *in vacuo,* long standing in desiccators with dehydrating agents, etc. *By dialyzing against a concentrated solution of dextrin* it is usually rather easy and simple to concentrate many such solutions to one tenth to one fiftieth of their volumes. There is no disturbing physical or chemical treatment; the process is relatively rapid, 4 to 18 hours of dialysis is in all probability sufficient for any requirement; and (in some cases the greatest advantage) the dialysis can be done under a low temperature in a refrigerator or cold room. Stirring will, of course, further hasten the process when speed is of very considerable importance, although at room temperature there will usually be no need for this.

The writer has used the process particularly for purifying and concentrating phosphatase extracts from kidneys. The work involved mostly dialysis of 10 or 20 cc only, although larger set-ups can be used, and there seems to be no reason why the process can not be of use on a commercial scale.

Cellophane tubing 1.9 cm in diameter with 0.00183 cm wall (Fisher Scientific Company ¾ inch diameter by 0.00072 inch wall) and about 13 cm in length was used most. If the lower half of a No. 2 rubber stopper is holed to contain a glass tube 1 cm outside diameter by about 5 cm long, the Cellophane may be readily slipped over the stopper and held by means of a rubber band or cord. The lower end of the Cellophane tube becomes completely impermeable when tied close with polished cord. If, however, a cord tie is not wanted in the solution the tubing may be cut twice as long, doubled back, and the cord end tied to the glass tube above the solution. The large inside diameter of the glass tube (about 8 mm) is best because it allows the free introduction of a pipette for adding or removing liquid from the inside of the dialysis tube.

Dialysis is best made against 45–50 per cent. of dextrin in water. Seventy-five per cent. dextrin solution is not difficult to prepare and can be used, but the viscosity is great and there is much precipitation on standing in a refrigerator. When 10 or 20 cc is to be concentrated the writer has found 200 cc 45–50 per cent. dextrin as the "outside solution" to be desirable. In a tall beaker or glass this conveniently submerges the Cellophane tube contents suspended from above and allows diffusion to take place readily.

The properties of dextrin make it very suitable, in fact outstandingly so, for the above process. Other colloids, such as albumin, gelatin, gum ghatti, acacia, starch, agar, pectin, etc., are not suitable.

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BOOKS RECEIVED

Dearborn, Walter F. and John W. M. Rothney. *Predicting the Child's Development.* Pp. 360. Sci-Art Publishers. $4.50.

Ford, Clellan S. *Smoke from their Fires; The Life of a Kwakiutl Chief.* Pp. 248. Illustrated. Yale University Press. $3.00.

Hayakawa, S. I. *Language in Action.* Pp. ix + 245. Harcourt, Brace. $2.00.

Porterfield, Austin L. *Creative Factors in Scientific Research.* Pp. xi + 282. Duke University Press. $3.50.

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U. S. Public Health Service. *Bulletin No. 265; Fatigue and Hours of Service of Interstate Truck Drivers.* Pp. xxiii + 286. Illustrated. Superintendent of Documents, Washington, D. C. $0.40.